



# **ANNUAL REPORT**

of

## **Iowa Highway Research Board Research and Development Activities FY 2008**

Attachment to  
FY 2008 Annual Report  
Research, Intelligent Transportation Systems, and  
Technology Transfer Activities

**DECEMBER 2008**



**ANNUAL REPORT  
OF  
IOWA HIGHWAY RESEARCH BOARD  
RESEARCH AND DEVELOPMENT ACTIVITIES**

**FOR THE  
FISCAL YEAR ENDING JUNE 30, 2008**

RESEARCH AND TECHNOLOGY BUREAU  
OPERATIONS RESEARCH  
(515) 239-1447  
[www.iowadot.gov/operationsresearch](http://www.iowadot.gov/operationsresearch)

HIGHWAY DIVISION  
IOWA DEPARTMENT OF TRANSPORTATION  
AMES, IOWA 50010

**DECEMBER 2008**

## TABLE OF CONTENTS

	Page
Research and Development.....	1
Iowa Highway Research Board .....	1
Table I - Iowa Highway Research Board Members.....	2
Research and Development Projects.....	4
In-House Research and Development.....	4
National Cooperative Highway Research Program .....	4
Secondary Road Traffic Count Program.....	5
Secondary Road Research Fund .....	5
Street Research Fund .....	6
Primary Road Research Fund .....	6
Projects Initiated During FY 2008.....	7
Projects Completed During FY 2008.....	8
Table II - Financial Summary of Research and Development Project Expenditures .....	9
Research Project Descriptions .....	12

## LIST OF ACRONYMS

AASHTO - American Association of State Highway and Transportation Officials	LVR - Low Volume Road
ACC - Asphalt Cement Concrete	MOVITE - Missouri Valley Section of the Institute of Transportation Engineers
ADV - Acoustic Doppler Velocimeter	NAT - Nottingham Asphalt Tester
APWA - American Public Works Association	NCHRP - National Cooperative Highway. Research Program
ASCE - American Society of Civil Engineers	NDT - Non-Destructive Testing
BMP - Best Management Practice	NPDES - National Pollution Discharge Elimination System
CIPR - Cold In-Place Recycling	NRCS - National Resource Conservation Service
CP - Concrete Pavement	PCA - Portland Cement Association
CPTP - Comprehensive Public Training Program	PCC - Portland Cement Concrete
CTRE - Center for Transportation Research and Education	PI - Principal Investigator
DOT - Department of Transportation	QA - Quality Assurance
DSM - Decision Support Model	QC - Quality Control
FHWA - Federal Highway Administration	QM-E - Quality Management - Earthwork
FRP - Fiber Reinforced Polymer	RC - Reinforced Concrete
FWD - Falling Weight Deflectometer	RRFC - Railroad Flat Car
GIS - Geographic Information System	RSAP - Roadside Safety Analysis Program
HMA - Hot Mix Asphalt	SHRP - Strategic Highway Research Program
IHRB - Iowa Highway Research Board	SUDAS - Statewide Urban Designs and Specifications
ISRCIM - Iowa Stormwater Runoff Control Interactive Manual	TAC - Technical Advisory Committee
ISU - Iowa State University	TRB - Transportation Research Board
LRFD - Load and Resistance Factor Design	USGS - United States Geological Survey
LTAP - Iowa State University Local Technical Assistance Program	

## **RESEARCH AND DEVELOPMENT**

The Highway Division of the Iowa Department of Transportation (Iowa DOT) engages in research and development for two reasons: first, to find workable solutions to the many problems that require more than ordinary, routine investigation; second, to identify and implement improved engineering and management practices.

This report, entitled “Iowa Highway Research Board Research and Development Activities FY2008” is submitted in compliance with Sections 310.36 and 312.3A, Code of Iowa, which direct the submission of a report of the Secondary Road Research Fund and the Street Research Fund respectively. It is a report of the status of research and development projects in progress on June 30, 2008; it is also a report on projects completed during the fiscal year beginning July 1, 2007, and ending June 30, 2008. Detailed information on each of the research and development projects mentioned in this report is available in the Research and Technology Bureau in the Highway Division of the Iowa Department of Transportation.

## **IOWA HIGHWAY RESEARCH BOARD**

In developing a progressive, continuing and coordinated program of research and development, the Highway Division is assisted by the Iowa Highway Research Board. This advisory group was established in 1949 by the Iowa State Highway Commission to respond to the research denoted in Section 310.36 of the Code of Iowa and now is denoted by 312.3A.

The Research Board consists of 15 regular members: seven Iowa county engineers, four Iowa DOT engineers, one representative from Iowa State University, one from The University of Iowa, and two engineers employed by Iowa municipalities. Each regular member may have an alternate who will serve at the request of the regular member. The regular members and their alternates are appointed for a three-year term. The membership of the Research Board as of June 30, 2008, is listed in Table I.

The Research Board held nine regular meetings during the period of July 1, 2007, to June 30, 2008. Suggestions for research and development were reviewed at these meetings and recommendations were made by the Board.



**TABLE I****2008 IOWA HIGHWAY RESEARCH BOARD****June 30, 2008**

<u>Member</u>	<u>Term Expires</u>	<u>Alternate</u>
Ahmad Abu-Hawash Chief Structural Engineer Iowa DOT - Bridges and Structures 800 Lincoln Way Ames, IA 50010 (515) 239-1393	12-31-09	Deanna Maifield Methods Engineer Iowa DOT – Office of Design 800 Lincoln Way Ames, IA 50010 (515) 239-1402
John Adam Deputy Director Iowa DOT - Statewide Operations Bureau 800 Lincoln Way Ames, IA 50010 (515) 239-1333	12-31-08	Will Zitterich Assistant Director Iowa DOT – Office of Maintenance 800 Lincoln Way Ames, IA 50010 (515) 239-1396
James Alleman Dept. of CCE Engineering Iowa State University 390 Town Engineering Bldg. Ames, IA 50011 (515) 294-3532	-	-
Dan Waid Hamilton County Engineer 2300 Superior Street, Suite 4 Webster City, IA 50595-3197 (515) 832-9520 SS# 040	12-31-08	Wade Weiss Green County Engineer 114 N. Chestnut Jefferson, IA 50129 (515) 386-3316 SS# 037
Vicki Dumdei District Engineer Hwy Div - District 2 1420 Fourth St. S.E. Mason City, IA 50401-4438 (641) 422-9465	12-31-10	Robert Younie Director Office of Maintenance 800 Lincoln Way Ames, IA 50010 (515) 239-1542
Keri Hornbuckle Dept. of Civil & Env. Engineering The University of Iowa 4138 Seamans Center Iowa City, IA 52242 (319) 384-0789	12-31-10	-
J. Jay Waddingham Franklin County Engineer 1341 Olive Avenue, PO Box 118 Hampton, IA 50441 (641) 456-4671 SS# 035	12-31-10 District 2	J.D. King Fayette County Engineer 114 N. Vine Street, PO Box 269 West Union, IA 52175 (563) 422-3552 SS# 033

Scott Rinehart  
Clay County Engineer  
300 W. 4<sup>th</sup> Street #5  
Spencer, IA 51301-2806  
(712) 262-2825 SS# 021

12-31-09  
District 3

Jim Berger  
Director  
Iowa DOT – Office of Materials  
800 Lincoln Way  
Ames, IA 50010  
(515) 239-1843

12-31-09

Mark Kerper  
Assistant Director  
Office of Location and Environment  
Iowa DOT  
800 Lincoln Way  
Ames, IA 50010  
(515) 239-1591

John Joiner  
Public Works Director  
515 Clark Avenue  
P.O. Box 811  
Ames, IA 50010  
(515) 239-5165

12-31-08

Ronald Knoche  
City Engineer  
410 E. Washington Street  
Iowa City, IA 52240-1825  
(319) 356-5138

Jeff Krist  
Project Manager  
Public Works Department  
209 Pearl Street  
Council Bluffs, IA 51503  
(712) 328-4635

12-31-09

Richard Fosse  
Director of Public Works  
410 E. Washington Street  
Iowa City, IA 52240-1825  
(319) 356-5141

Mark Nahra  
Delaware County Engineer  
2139 Highway 38  
P.O. Box 68  
Delaware, IA 52036  
(563) 927-3505 SS# 028

-

-

John Rasmussen  
Pottawattamie County Engineer  
223 South 6<sup>th</sup> Street  
Council Bluffs, IA 51501  
(712) 328-5608 SS# 078

12-31-08  
District 4

Daniel Ahart  
Shelby County Engineer  
1313 Industrial Parkway  
Harlan, IA 51537  
(712) 755-5954 SS#083

Brian Moore  
Wapello County Engineer  
536 Mill St.  
Ottumwa, Iowa 52501  
(641) 684-5425 SS# 090

12-31-10  
District 5

Steve Akes  
Warren County Engineer  
301 N. Buxton #211  
Indianola, IA 50125  
(515) 961-1050 SS# 091

Steve Gannon  
Linn County Engineer  
1888 County Home Road  
Marion, IA 52302-9753  
(319) 892-6400 SS# 057

12-31-09  
District 6

Clark Schloz  
Jackson County Engineer  
201 W. Platt  
Maquoketa, IA 52060  
(563) 652-4782 SS#049

## **RESEARCH AND DEVELOPMENT PROJECTS**

Proposals for research and development are reviewed by the Iowa Highway Research Board, and its recommendations are transmitted to the Director of the Highway Division of the Department of Transportation. Expenditure of funds for research and development is then authorized on an individual project basis.

These expenditures may be charged to the Primary Road Research Fund, Secondary Road Research Fund or the Street Research Fund, depending on which road system will benefit from the project. If more than one jurisdiction's roads share in the benefits, the costs are shared.

Table II is a record of expenditures for research and development made during the fiscal year ending June 30, 2008. Total expenditure was \$1,952,439.10.

## **IN-HOUSE RESEARCH AND DEVELOPMENT**

Research and development projects performed by Iowa DOT personnel are termed "in-house" projects. These projects may involve other departmental and field personnel in addition to personnel from the Research and Technology Bureau, Operations Research Section. In many instances, personnel from other offices are designated as principal investigator, which means that they have a major role in the planning, performance and analysis of the research.

Contract research funds may be used for material and equipment costs for in-house research, but cannot be used for salary or personal expenses of the participating personnel. Consequently, the contract amounts for in-house projects are relatively small. The Research and Technology Bureau, Operations Research Section, wishes to express its appreciation to other offices for their assistance.

## **NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM**

The National Cooperative Highway Research Program (NCHRP) was organized by the American Association of State Highway Officials (now the American Association of State Highway and Transportation Officials—AASHTO). The program is administered by the Transportation Research Board (TRB), a branch of the National Academy of Sciences.

The purpose of NCHRP is to provide the funds and direction for research in highway matters of national concern. The program is funded annually by all of the states in an amount equal to 0.055 percent of the federal aid allocated to the states for highways. Iowa's obligation and actual expenditure for NCHRP varies and may be influenced by billing practices.

## SECONDARY ROAD TRAFFIC COUNT PROGRAM

Secondary road traffic counts and road inventories are conducted annually and funded from the Secondary Road Research Fund as Non-contract Engineering Studies. The Office of Transportation Data conducted traffic counts in 25 counties during fiscal year 2008 as part of the Annual Traffic Count Program. This activity consisted of 6500 portable recorder classification counts, 80 portable recorder volume counts and 50 manual counts. Traffic volumes from these counts are used to develop Motor Vehicle Traffic Flow Maps for each county showing the Annual Average Daily Traffic (AADT) on specific road sections within each county.

Secondary roads geometrics and current condition inventories were requested from and were submitted by 99 counties. This data provides county engineers, highway engineers, planners and administrators with essential information needed to determine design standards, to systematically classify highways, and to develop programs for improvement in maintenance of secondary roads.

## SECONDARY ROAD RESEARCH FUND

Section 310.34 of the Iowa Code authorizes the Iowa Department of Transportation to set aside each year an amount not to exceed 1½ percent of the receipts to the Farm-to-Market Fund in a fund to be known as the Secondary Road Research Fund. This authorization was first made in 1949; it was repealed in 1963 and reinstated in 1965. When the fund was reinstated, the use was designated to finance engineering studies and research projects. The Iowa Department of Transportation accounting procedure for the Secondary Road Research Fund is based on obligations for expenditures on research projects and not the actual expenditures. The fiscal year 2008 financial summary is:

Beginning Balance 7-1-07		\$1,885,506.70
Receipts		
State Road Use Tax Fund		
(1½% of receipts)	\$1,216,110.72	
Federal Aid Secondary		
(1½% of receipts)	0.00	
Research Income	<u>0.00</u>	
Sub-Total		<u>\$1,216,110.72</u>
Total Funds Available		\$3,101,617.42
Obligation for Expenditures		
Obligated for		
Contract Research	\$953,396.51	
Non-Contract		
Engineering Studies	<u>\$261,742.89</u>	
Total Expenditures		<u>\$1,215,139.40</u>
Ending Balance 6-30-08		\$1,886,478.02

## STREET RESEARCH FUND

The Street Research Fund was established in 1989 under Section 312.3A of the Iowa Code. Each year \$200,000 is set aside from the street construction fund solely for the purpose of financing engineering studies and research projects, which have as their objective the more efficient use of funds and materials available for construction and maintenance of city streets. The Iowa Department of Transportation accounting procedure for the Street Research Fund is based on obligations for expenditures on research projects and not the actual expenditures. The fiscal year 2008 financial summary is:

Beginning Balance (7-1-07)	\$ 21,360
FY08 Street Research Funding	<u>\$200,000</u>
Total Funds Available for Street Research	\$221,360
Total Obligated for Expenditure FY08	<u>\$191,519</u>
Ending Unobligated Balance 6-30-08	\$29,841

## PRIMARY ROAD RESEARCH FUND

The Primary Road Research Fund is from non-obligated funds of the Primary Road Fund. These funds can only be expended on Iowa DOT projects for which the funds were reserved, such as contracted research and project-specific research supplies or equipment. An estimate of Primary Road Research Fund expenditures is made prior to the beginning of each fiscal year. The amount expended for contract research from the Primary Road Research Fund for FY08 was \$575,156.58 and the estimate for FY09 is \$750,000.

## PROJECTS INITIATED DURING FY 2008

TR-576	Investigation of Electromagnetic Gauges for Determination of In-Place Density of HMA Pavements - Phase II
TR-577	Evaluation of Rumble Stripes on Low Volume Rural Roads in Iowa
TR-578	Development of Mix Design Process for Cold In-Place Recycling Using Emulsion - Phase 3
TR-579	Low Cost Strategies to Reduce Speed and Crashes on Curves
TR-580	Pavement Markings and Safety
TR-581	Development of an Improved Agricultural-Based Deicing Product
TR-582	Ethanol By-Product Geo-Material Stabilization
TR-583	Field Testing of Piles & Development of a Wave Equation Method for Pile Design in IA
TR-584	Establishing a Dynamic Formula for Pile Design & Construction Control of Pile Driving
TR-585	National Agriculture Image Program Participation
TR-586	Pavement Thickness Design for Local Roads in Iowa
TR-587	Impact of Low Shrinkage Mixes on Late-age Random Cracking in Pavements with Use of Early Entry Sawing
TR-588	Statewide Consultant Services from Stanley Consultants, Update Bridge "J" Standards
TR-589	Updating U.S. Precipitation Frequency Estimates for the Midwestern Region
TR-590	Cold In-Place Recycling (TR-553) Phase II-Measuring Temperature, Moisture, Deflection and Distress for the Test Section
TR-591	Stabilization Procedures to Mitigate Edge Rutting for Granular Shoulders
TR-592	Bridge Rails and Approach Railing for Low-Volume Roads in Iowa
TR-593	Infrastructure Impacts on Iowa's Changing Economy
TR-594	Development of Non-Petroleum Based Binders for Use in Flexible Pavements

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**19 Projects Total**

## PROJECTS COMPLETED DURING FY 2008

The following projects were completed during FY 2008 and the project final reports were approved by the Iowa Highway Research Board:

<b>Project Number</b>	<b>Title</b>	<b>Report Approved</b>
TR-492	Embankment Quality Phase IV - Application to Unsuitable Soils	10/15/2007
TR-493	Performance Evaluation of Steel Bridges: Phase II	12/5/2007
TR-498	Field Testing of Railroad Flat Car Bridges	9/28/2007
TR-505	Improving PCC Mix Consistency & Production by Mixing Improvements	2/29/2008
TR-507	Thin Maintenance Surfaces Phase III - Municipal Streets and Low-Volume Rural Roads	8/24/2007
TR-520	Evaluation of Dowel Bar Retrofits for Local Road Pavements	2/29/2008
TR-522	Investigation of Steel Stringer Bridges: Substructures and Superstructures	10/26/2007
TR-523	Appropriate Traffic Calming Techniques for Small Iowa Communities	12/6/2007
TR-530	Development of an Improved Integral Bridge Abutment-to-Approach Slab Connection	6/27/2008
TR-534	Design Procedures and Field Monitoring of Submerged Barbs for Streambank Protection	9/28/2007
TR-539	Instrumentation and Monitoring of Precast, Post-tensioned Bridge Approach Pavement	6/27/2008
TR-540	Developing Guidance for Use of Lighting on Rural and Urban Roadways in Iowa	2/29/2008
TR-549	Roadway Design Standards for Rural and Suburban Subdivisions	8/24/2007
TR-550	Performance Evaluation of Rubblized Pavements in Iowa	4/25/2008
TR-552	Field Evaluation of Timber Preservation Treatments for Iowa Highway Applications	1/25/2008
TR-553	Examination of Curing Criteria for Cold In-Place Recycling	2/29/2008
TR-557	Evaluation of Lignin Derived from Agricultural Co-Products as an Antioxidant in Asphalt	5/30/2008
TR-559	Improved Method for Determining Wind Loads on Highway Sign and Traffic-Signal Structures	1/25/2008
TR-565	Implementation of Recommendations into SUDAS Specifications (Phase II of TR-524)	4/25/2008

**19 Total**

## Table II

### FINANCIAL SUMMARY OF RESEARCH AND DEVELOPMENT PROJECT EXPENDITURES

July 1, 2007 to June 30, 2008

*(Active projects with no current fiscal year expenditures are not included)*

Project	Project Title	Primary Road	Secondary Road	Street	Total
		Research Fund	Research Fund	Research Fund	
		<u>Expenditures</u>	<u>Expenditures</u>	<u>Expenditures</u>	<u>Expenditures</u>
140	Collection and Analysis of Stream Flow Data	55,594.75	113,792.00		169,386.75
296	ISU Local Technical Assistance Program (LTAP)	19,037.78	74,990.75	13,000.00	107,028.53
375	TRB Education for County Engineers		4,421.01		4,421.01
428	Effective Structural Concrete Repair		139.00		139.00
460	Living Snow Fence	\$4,396.16	4,396.18		8,792.34
471	Evaluation of Non-Corrosive Deicing Materials and Corrosion Reducing Treatments for Deicing Salts	\$5,999.98	3,499.99	500.00	9,999.97
474	Development of a Mix Design Process for Cold-In-Place Rehabilitation Using Foamed Asphalt	16,230.79	9,467.99	1,352.51	27,051.29
496	Design of Single Span Pretensioned, Prestressed Concrete Beam Bridge Standards with Concrete Abutments		3,670.93		3,670.93
498	Field Testing of Railroad Flat Car Bridges		19,315.91		19,315.91
501	Optimization and Management of Materials in Earthwork Construction		3,467.04		3,467.04
502	Evaluation of Long Term Field Performance of CIPR Roads	3,891.41	1,367.41		5,258.82
505	Improving PCC Mix by Mixing Improvements	7,414.43	6,135.93	3,796.06	17,346.42
519	Developing Flood-Frequency Discharge Estimation Methods for Small Drainage Basins in Iowa		52,250.00		52,250.00
520	Evaluation of Dowel Bar Retrofits for Local Road Pavements		11,890.19	1,224.77	13,114.96
522	Investigation of Steel Stringer Bridges		3,247.46	1,087.39	4,334.85
523	Traffic Calming Techniques for Small Iowa Communities	4,735.86	2,452.27	2,128.78	9,316.91
528	Determining Design Year Traffic Demands			105.84	105.84
529	Construction and Evaluation of a Prestressed Concrete Bridge Constructed Using Ultra High-Performance Concrete	34,266.30	14,272.64		48,538.94
530	Development of an Improved Integral Bridge Abutment-to-Approach Slab Connection	15,469.56	14,484.51	5,388.75	35,342.82
531	Effective Shoulder Design and Maintenance	2,144.91	2,483.21		4,628.12
533	Design Flood Frequency Methods for Iowa Streams	22,414.35			22,414.35
534	Design Procedures and Field Monitoring of Submerged Barbs for Streambank Protection	6,720.00	6,720.02	560.00	14,000.02
536	Implementation of the Water Quality Control BMPs & Design & Specifications Manuals		1,336.00		1,336.00
539	Instrumentation and Monitoring of Precast, Post-tensioned Bridge Approach Pavement	40,009.15	8,298.40		48,307.55
540	Developing Guidance for Use of Lighting in Iowa	9,700.39	1,233.08	2,497.00	13,430.47
541	The Effects of Headcut and Knickpoint Propagation on Bridges	2,550.02	3,187.39	637.50	6,374.91
545	Development of Self-Cleaning Box Culvert Designs	2,119.53	27,309.08	6,409.11	35,837.72
546	Revision to the SUDAS Traffic Signal Design Guide	15,250.26	10,373.76		25,624.02



Project	Project Title	Primary Road	Secondary Road	Street	Total
		Research Fund	Research Fund	Research Fund	
		Expenditures	Expenditures	Expenditures	Expenditures
549	Roadway Design Standards for Rural and Suburban Subdivisions	11,839.72	3,071.56	941.44	15,852.72
550	Performance Evaluation of Rubblized Pavements in Iowa			1,413.19	1,413.19
551	Local Agency Pavement Marking Plan	7,476.34	22,164.66	3,658.92	33,299.92
552	Field Evaluation of Timber Preservation Treatments for Iowa Highway Applications	29,160.97	20,823.58	1,462.20	51,446.75
553	Examination of Curing Criteria for Cold In-Place Recycling	14,152.06	2,918.65	6,002.24	23,072.95
554	Performance & Evaluation of Concrete Pavement Granular Subbase	49,967.19	39,045.61	2,573.40	91,586.20
555	Evaluation of Hot Mix Asphalt Moisture Sensitivity using the Nottingham Asphalt Test Equipment	2,391.69	3,595.63	598.44	6,585.76
556	Feasibility Investigation of Segmentally Precast Bridge Piers for Accelerated Construction	18,026.05	23,034.24	4,213.11	45,273.40
557	Evaluation of Lignin Derived from Agricultural Co-Products as an Antioxidant in Asphalt	1,453.36	7,752.19	2,504.40	11,709.95
558	Use of Ultra-High Performance Concrete in Geotechnical and Substructure Applications	8,964.05	15,980.41	903.41	25,847.87
559	Improved Method for Determining Wind Loads on Highway Sign and Traffic-Signal Structures		9,571.29		9,571.29
560	Clear Zone - A Synthesis of Practice and Benefits of Meeting the Ten-Foot Clear Zone Goal on Urban Streets	9,240.00	11,452.96		20,692.96
561	Precast Bridge Elements	40,515.43	12,181.06	4,503.09	57,199.58
562	Monitoring Wind-Induced Vibrations/Stresses in a High Mast Lighting Tower	5,669.93			5,669.93
564	Adding Scour Estimation to the Iowa Bridge Backwater Software	4,104.00	4,284.00		8,388.00
565	Implementation of Recommendations into SUDAS Specifications (Phase II of TR-524)	16,035.78	5,910.20	5,802.96	27,748.94
566	Investigation of Utility Cut Repair Techniques to Reduce Settlement in Repair Areas	17,261.64	42,850.80	16,532.00	76,644.44
567	Development of Stage-Discharge Relations for Ungaged Bridge Waterways		44,278.49	4,796.00	49,074.49
568	Modified Sheet Pile Abutments for Low Volume Bridges	5,805.15	44,818.04	6,229.12	56,852.31
569	Quantitative Mapping of Waterways at Bridge Sites		18,070.92		18,070.92
570	Identification of Practices, Design, Construction and Repair Using Trenchless Technology	7,111.34	64,543.84	12,627.45	84,282.63
572	Improving Safety for Slow Moving Vehicles on Iowa's High-Speed Rural Roadways	6,403.02	21,387.49		27,790.51
573	Development of LRFD Design Procedures for Bridge Piles	5,327.44	65,944.85		71,272.29
574	Structural Design Construction & Evaluation of a Pre-stressed Concrete Bridge Using UHPC Pi Girders	2,725.44	10,369.80		13,095.24
576	Investigation of Electromagnetic Gauges for Determination of In-Place Density of HMA Pavements - Phase II	9,095.43	16,308.41	3,728.67	29,132.51
577	Evaluation of Rumble Stripes on Rural Roads in Iowa	1,620.73		523.82	2,144.55
578	Development of Mix Design Process for Cold In-Place Recycling Using Emulsion - Phase 3	2,489.94	9,926.90	5,093.32	17,510.16
579	Strategies to Reduce Speed and Crashes on Curves	12,431.53	1,910.71	3,559.36	17,901.60
		Primary Road	Secondary Road	Street	

<u>Project</u>	<u>Project Title</u>	Research Fund <u>Expenditures</u>	Research Fund <u>Expenditures</u>	Research Fund <u>Expenditures</u>	Total <u>Expenditures</u>
580	Pavement Markings and Safety			604.80	604.80
581	Development of an Improved Agricultural-Based Deicing Product	4,820.12	7,825.19	1,818.68	14,463.99
583	Field Testing of Piles & Development of a Wave Equation Method for Pile Design in IA	4,551.73	4,490.53		9,042.26
587	Impact of Low Shrinkage Mixes on Late-age Random Cracking in Pavements with Use of Early Entry Sawing	5,118.93			5,118.93
591	Stabilization to Mitigate Edge Rutting for Granular Shoulders	3,451.94			3,451.94
1027	Secondary Road Research Coordinator		144,908.63		144,908.63
	Contract Research Subtotal	575,156.58	1,083,622.79	128,777.73	1,787,557.10
SPR- PL- 1(44)	FY 2008 Transportation Inventory Engineering Studies		164,882.00		164,882.00
	<b>Total of Expenditures</b>	575,156.58	1,248,504.79	128,777.73	1,952,439.10

## HR-140

**Agency:**  
United States  
Geological Survey

**Principal Investigator:**  
Rob Middlemis-Brown

**Research Period:**  
July 1, 1967 to  
September 30, 2009  
Annual Renewal

**Research Board Funding:**  
\$234,257

**Funding Source:**  
45% Federal funds,  
55% State - 40%  
Primary funds, 50%  
Secondary funds and  
10% Street funds

## Collection and Analysis of Stream Flow Data

**Objective:** To collect the data necessary for analytical studies (including flood-frequency discharge estimation) and to define, for any location, the statistical properties and trends in discharge or elevation of streams, lakes, and reservoirs. To define the water-surface-elevation profiles and corresponding discharges along streams in basins with at least 100 mi<sup>2</sup> of drainage area for selected floods. Evaluate the flood characteristics and hydraulics at existing and proposed flow structures in basins of all sizes when requested.

**Progress:** Data collection and annual reporting of stream flow data is ongoing annually. Extensive flooding in Iowa during June, 2008 resulted in researchers being asked to create several special Flood Event Reports.

**Reports:** Annual Report, Flood Event Reports

**Implementation:** Flood frequency and discharge data is used for sizing hydraulic structures in Iowa. Structure design agencies use this data for their designs.



Acoustic Doppler Current Profiler (ADCP) in use at Duck Creek during Davenport flood in March, 2007 - Photo: U.S. Geological Survey

## HR-296

**Agency:**  
Iowa State University

**Principal Investigator:**  
Duane Smith

**Research Period:**  
October 1, 1986 to  
December 31, 2008

**Research Board Funding:**  
\$130,000

**Funding Source:**  
35.9% Federal funds,  
15.4% 402 Safety  
funds, 14.4%  
ISU/Midwest  
Transportation Center  
funds, 8.7%  
Workshop income  
funds and 25.6% State  
- 10% Primary funds,  
45% Secondary funds  
and 45% Street funds

*promote research -  
encourage implementation -  
distribute research data*

## Iowa State University Local Technical Assistance Program (LTAP)

**Objective:** To help Iowa's local governments keep up with growing demands on local roads, streets, bridges, and public transportation. The center provides technical and management assistance to Iowa's local transportation officials through a variety of programs.

**Progress:** Major ongoing tasks are to:

- Publish at least six *Technology News* newsletters per year
- Conduct at least 10 training courses/workshops per year
- Distribute publications
- Provide service and information to users
- Present transportation safety information to rural communities by employing a Transportation Safety Circuit Rider

**Reports:** Newsletters

**Implementation:** Implementation of research findings and the proper training of state and county employees will improve the quality and reduce the cost of road construction and maintenance.



Participants at the 2007 Expo discover the latest technology and equipment.



## HR-375

**Agency:**

Iowa Department of  
Transportation,  
Highway Division

**Principal  
Investigator:**

Edward J. Engle

**Research Period:**

November 1, 1994 –  
on-going

**Research Board  
Funding:**

\$37,400

**Funding Source:**

100% State -  
100% Secondary  
funds

## Transportation Research Board Education for County Engineers

**Objective:** To send two county engineers annually to the Transportation Research Board (TRB) Annual Meeting in Washington, D.C., for research education. County engineers selected are generally those starting their term as regular members of the IHRB. The experience of attending the TRB Annual Meeting gives county engineers serving on the IHRB a better understanding of research at a national and international level. Additional benefits may be gained as the county engineers begin to develop ideas for research from their experience at the TRB meeting.

**Progress:** In the time period 1995 to 2008, a total of 22 county engineers have been sent to TRB.

**Reports:** None

**Implementation:** All county engineers who have attended the conference so far thought it was a very good educational experience. They believe the experience will allow them to better serve their counties and the IHRB.



County engineers discuss various topics of interest at TRB - *Photo: The Transportation Research Board, Washington, D.C.*

## TR-428

**Agency:**  
Iowa State University

**Principal Investigator:**  
F. Wayne Klaiber and  
Terry J. Wipf

**Research Period:**  
February 1, 1999 to  
December 31, 2008

**Research Board Funding:**  
\$294,760

**Funding Source:**  
100% State -  
45% Primary funds,  
45% Secondary funds  
and 10% Street funds

## Effective Structural Concrete Repair

**Objective:** To develop innovative repair methods and/or materials that result in cost effective repair of structural concrete elements.

**Progress:** A final report summarizing the work to date was presented at the April 2004 meeting. Also, a synopsis of the installation procedures used for each of the Fiber Reinforced Polymers (FRP) wraps has been created for use by maintenance personnel. The synopsis is included as an appendix to the final report. A revised final report will be prepared in 2008 to reflect the service life of the documented repairs.

**Reports:** Final Report, April 2004

**Implementation:** Results from this investigation will provide technical information that bridge and other engineers can use to lengthen the useful life of structural concrete bridges.



Installation of transverse CFRP jacket on Beam

## TR-450

**Agency:**

Purdue University and  
sub-contract with  
Iowa State University

**Principal  
Investigator:**

Rebecca S. McDaniel  
(Purdue University)  
and Brian Coree  
(Iowa State  
University)

**Research Period:**

June 1, 2001 to  
June 30, 2007

**Research Board  
Funding:**

\$80,000 (Purdue  
University - \$23,674;  
Iowa State University  
- \$56,326)

**Funding Source:**

Pooled funds  
coordinated by North  
Central Superpave  
Center at Purdue  
University - 50%  
Institute for Safe,  
Quiet, and Durable  
Highways funds, 25%  
Indiana DOT funds  
and 25% State -  
100% Primary funds

## Identification of Laboratory Techniques to Optimize Superpave HMA Surface Friction Characteristics

**Objective:** To evaluate various blends of aggregates to optimize the combination of micro- and macro-texture to achieve a desired level of friction. Aggregate classifications and properties currently used to provide desirable friction levels for high traffic situations will be evaluated and possibly revised based upon this research.

**Progress:** The draft final report is being written and will be delivered in January 2009.

**Reports:** None

**Implementation:** These research findings are expected to identify blends of aggregates that can be used in Iowa to maintain the current baseline of friction. It is anticipated that increase macrotexture will diminish the need for high quality friction aggregates to provide increased microtexture. This will lead to more economical surface courses for use in Iowa by reducing the need to import friction aggregates.

## TR-458

**Agency:**

The University of  
Iowa

**Principal****Investigator:**

Wilfrid A. Nixon

**Research Period:**

May 1, 2001 to  
April 30, 2006

**Research Board****Funding:**

\$151,920

**Funding Source:**

100% State -  
30% Primary funds,  
60% Secondary funds  
and 10% Street funds

## Field Testing of Abrasive Delivery Systems in Winter Maintenance

**Objective:** To conduct a series of experiments aimed at improving the ability of abrasives to increase friction on snow and ice-covered roads. Two novel delivery methods will be tested and compared with existing delivery methods, using a friction measuring device. It is expected that friction increases due to abrasives will diminish more slowly with the two delivery methods than with existing delivery methods.

**Progress:** Delays resulting from obtaining appropriate winter conditions for testing as well as administrative delays have slowed progress on this project. It is anticipated that a final report will be prepared in 2008.

**Reports:** None

**Implementation:** Maintaining roads in winter in Iowa is difficult. The safety of the driving public is paramount. If one of these novel abrasive delivery methods proves more effective than conventional methods and is cost-effective, then winter maintenance will be more easily performed and the driving public will be safer.



Sander Chute in Operation Mode



## TR-468

**Agency:**

Iowa Department of  
Transportation

**Principal  
Investigator:**

Mark J. Dunn

**Research Period:**

December 1, 2001,  
on-going

**Research Board  
Funding:**

\$10,000

**Funding Source:**

100% State -  
40% Primary funds,  
50% Secondary funds  
and 10% Street funds

## Technology Transfer Program for the Iowa Highway Research Board

**Objective:** The objective of this project is to provide improved research technology transfer and information distribution to the IHRB and to transportation professionals in Iowa.

This project also provides resources to cover facility costs for small workshops related to IHRB research when it would be beneficial to transfer technology.

**Progress:** This project covers meeting costs for the Iowa Highway Research Board's annual travel meeting at field sites in Iowa. Costs for the digital conversion of research report HR-29 "Drainage Areas for Iowa Streams" were also covered by this project.

**Reports:** None



## TR-472

**Agency:**

The University of  
Iowa

**Principal  
Investigator:**

Wilfrid A. Nixon

**Research Period:**

May 1, 2002 to  
December 31, 2004

**Research Board  
Funding:**

\$80,000

**Funding Source:**

100% State -  
60% Primary funds,  
35% Secondary funds  
and 5% Street funds

## Investigation of Materials for the Reduction and Prevention of Corrosion on Highway Maintenance Equipment

**Objective:** To find methods that can effectively and economically reduce corrosion on maintenance vehicles, especially when liquid deicing chemicals are being used.

**Progress:** There have been numerous delays in the progress of this project. All tests have been completed and an economic analysis is currently underway. It is anticipated that the final report will be complete in 2008.

**Reports:** None

**Implementation:** The result of this study will be presented at an appropriate meeting in Iowa after completion of the project. The report would also be made available via email to all subscribers on the snow and ice mailing list.



Corrosion on snow plow blade

## **TR-480 (SD2002-01)**

**Agency:**  
Michigan  
Technological  
University

**Principal  
Investigator:**  
Lawrence L. Sutter

**Research Period:**  
July 15, 2002 to  
June 30, 2007

**Research Board  
Funding:**  
\$80,000

**Funding Source:**  
Multi-state pooled  
funds coordinated by  
South Dakota  
Department of  
Transportation -  
86.7% other sources  
and 13.3% State -  
45% Primary funds,  
45% Secondary funds  
and 10% Street funds

## **Investigation of the Long Term Effects of Concentrated Salt Solutions on Portland Cement Concrete**

### **Objective:**

- Determine the long-term effects of concentrated solutions of magnesium, sodium and calcium chloride as well as calcium magnesium acetate or other alternative liquid deicers on durable Portland cement concrete.
- Estimate the potential for reduction in performance and service life for pavements (jointed plain, reinforced and continuously reinforced) and structures subjected to various concentrated deicing brines.

**Reports:** Final Report, April 2008

**Implementation:** The results of this research may be used to aid in the decision-making processes, with respect to the continued use of concentrated liquid deicers, while minimizing any potential damage to concrete pavements and structures.

## TR-488

**Agency:**

The University of  
Iowa

**Principal  
Investigator:**

Wilfrid A. Nixon

**Research Period:**

February 1, 2003 to  
July 31, 2005

**Research Board  
Funding:**

\$90,000

**Funding Source:**

100% State -  
70% Primary funds,  
25% Secondary funds  
and 5% Street funds

## Economics of Using Calcium Chloride vs. Sodium Chloride for Deicing & Anti-icing

**Objective:** To determine what mixture of calcium chloride and sodium chloride when applied to the road surface under winter weather conditions provides the best possible level of service to the public in the most economical way possible. In addition, economic factors, as well as ice melting capability, will be considered and operational impacts will be a major factor of consideration.

**Progress:** There have been numerous delays in the progress of this project; completion of the final report is anticipated in 2008.

**Reports:** None

**Implementation:** The result of this study will be presented at an appropriate meeting in Iowa after completion of the project. The report will also be made available via e-mail to all subscribers listed on the Snow and Ice mailing list and will be placed on the Snow and Ice Cooperative Program Web site at [www.sicop.net](http://www.sicop.net).

## TR-491

**Agency:**

The University of  
Iowa

**Principal  
Investigator:**

Wilfrid A. Nixon

**Research Period:**

July 1, 2003 to  
June 30, 2005

**Research Board  
Funding:**

\$100,000

**Funding Source:**

100% State -  
80% Primary funds,  
10% Secondary funds  
and 10% Street funds

## Development of Winter Performance Measures for Maintenance Operations

**Objective:** To create a method for measuring performance levels of winter maintenance operations during winter storms. The method must consider the severity of the storm, and must be able to measure the outcomes of the winter maintenance actions in such a way as to cumulatively assess the performance of those actions.

**Progress:** There have been numerous delays in this project's progress. It is anticipated that the final report will be complete in 2008.

**Reports:** None

**Implementation:** The results of this study will be presented at an appropriate meeting in Iowa after completion of the project. The report would also be made available via e-mail to all subscribers to the snow and ice mailing list. The final report will be made available in PDF format.



Iowa DOT Maintenance Operations removing snow from a roadway during a winter storm.



## TR-492

**Agency:**  
Iowa State University

**Principal Investigator:**  
David J. White

**Research Period:**  
May 1, 2003 to  
September 30, 2007

**Research Board Funding:**  
\$169,067

**Funding Source:**  
100% State -  
70% Primary funds,  
15% Secondary funds  
and 15% Street funds

## Embankment Quality Phase IV - Application to Unsuitable Soils

**Objective:** To continue development and refinement of the Quality Management Earthwork (QM-E) program, but with effort focused specifically on “unsuitable” soils. This phase will provide additional Grading Certification Level I training of contractor and field personnel on two separate pilot projects - preferably one in western Iowa and one in southern Iowa. The outcomes of this phase will be:

- Final recommendations for QM-E implementation
- A proposed Iowa DOT developmental specification
- Improved data management tools for contractor quality control (QC) and Iowa DOT quality assurance (QA)

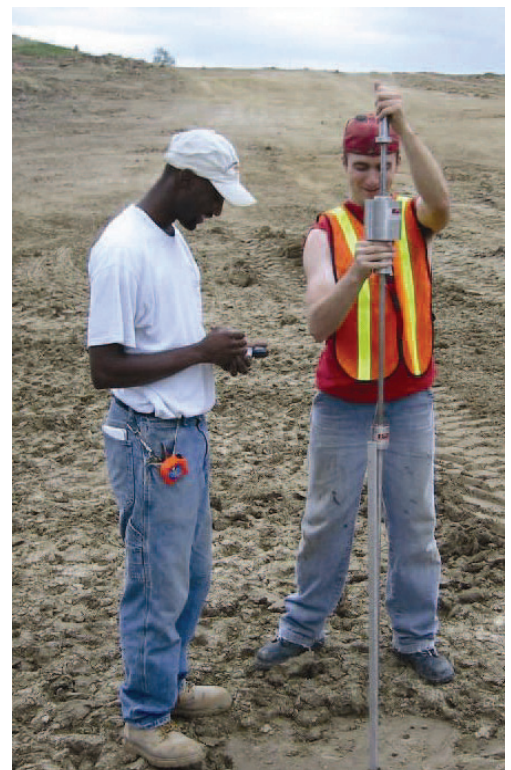
**Reports:** Final Report, October 2007

**Implementation:** The results of this research and pilot studies will be used as a basis for developing statewide specification changes for improved roadway embankments.



Shelby tube soil sampling in the field

Geotechnical  
Remote  
Acquisition of  
Data (G-RAD)  
system with GPS attachment



DCP testing conducted using G-RAD

## TR-493

**Agency:**  
Iowa State University

**Principal Investigator:**  
Terry J. Wipf

**Research Period:**  
May 1, 2003 to  
December 31, 2006

**Research Board Funding:**  
\$196,421

**Funding Source:**  
100% State -  
75% Primary funds,  
20% Secondary funds  
and 5% Street funds

## Performance Evaluation of Steel Bridges - Phase II

**Objective:** To study the performance of bridges with suspect or untested design details and to develop a low-cost system for use by secondary road bridge owners to easily monitor the conditions of infrastructure.

**Reports:** Final Report, December 2007

**Implementation:** The product of this research will be a better understanding of two types of primary road bridges and the development of a low-cost monitoring system for secondary road bridges. With the behavior information for the primary road bridge, the bridge owner will likely gain confidence in the performance of two bridge types. Also, secondary road bridge owners will have a low-cost system for monitoring bridges for specific behaviors or events.



Side view of the US 30 steel bridge

## TR-498

**Agency:**  
Iowa State University

**Principal Investigator:**  
F. Wayne Klaiber and  
Terry J. Wipf

**Research Period:**  
June 1, 2003 to  
August 31, 2007

**Research Board Funding:**  
\$192,958

**Funding Source:**  
100% State -  
100% Secondary  
funds

## Field Testing of Railroad Flat Car (RRFC) Bridges

**Objective:** To obtain more data on the structural behavior of additional RRFC bridges. When this project was initially proposed, only two RRFC demonstration bridges had been constructed and tested. Numerous other variables needed to be investigated. Refinement of the design methodology presented in TR-444 was needed, as well as the development of a load rating process for these types of bridges.

In June, 2005, the need to investigate continuous span RRFC bridges became apparent and thus an extension to the current project to include the testing of three continuous span bridges was proposed and approved by the IHRB.

**Reports:** Final Report, September 2007

**Implementation:** This research will provide counties with a bridge superstructure alternative that is relatively inexpensive and easy to install. Results of this investigation will improve the design methodology previously developed in TR-444. The rating methodology developed in this investigation will make it possible for county engineers and consultants to rate RRFC bridges.



The finished Buchanan County RRFC Bridge



## TR-501

**Agency:**  
Iowa State University

**Principal Investigator:**  
Vern Schaefer

**Research Period:**  
January 1, 2004 to  
February 29, 2008

**Research Board Funding:**  
\$175,000

**Funding Source:**  
100% State -  
45% Primary funds,  
45% Secondary funds  
and 10% Street funds

## Optimization and Management of Materials in Earthwork Construction

**Objective:** Objectives are to:

- Identify the impact of not doing material management and optimization through a forensic study of recent geotechnical problems and failures in Iowa.
- Determine appropriate parameter values to use in optimizing geotechnical system performance and material placement (i.e. shear strength, volumetric stability) in particular geotechnical applications, including subgrades, retaining structures, embankments, box culverts, and foundations.
- Develop guidelines (i.e. flow chart) for selection, mixing, stabilization and/or ground improvement of materials that provide desired engineering properties to obtain optimal performance for the various applications.
- Provide recommendations for Phase II pilot studies and development of design tools/software.

**Reports:** Work continues on the final report. Completion is expected in February 2009.

**Implementation:** In addition to the written report, a summary sheet will be created, and presentations will be made at appropriate local and regional conferences. The observations and conclusions from this study will provide recommendations for better management and optimization of on-site and select earth materials through the use of new ground improvement technologies. State, county, and local transportation agencies and contractors can implement the recommendations for improved geotechnical construction.



Soil mixing operation through layered soils, Des Moines, Iowa

## TR-505

**Agency:**  
Iowa State University

**Principal Investigator:**  
Vernon R. Schaefer

**Research Period:**  
October 1, 2003 to  
December 31, 2006

**Research Board Funding:**  
\$164,764

**Funding Source:**  
50% Federal funds  
and 50% State -  
70% Primary funds,  
15% Secondary funds  
and 15% Street funds

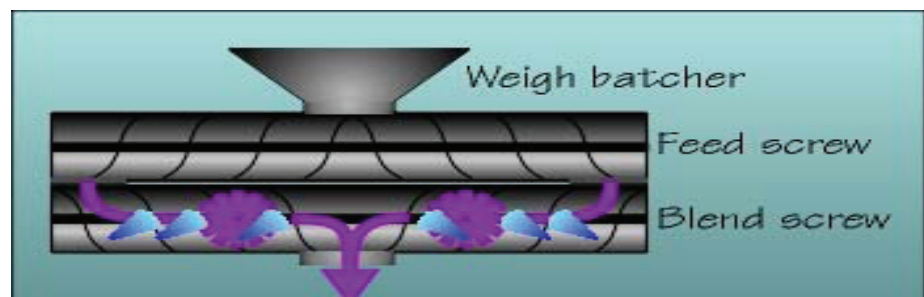
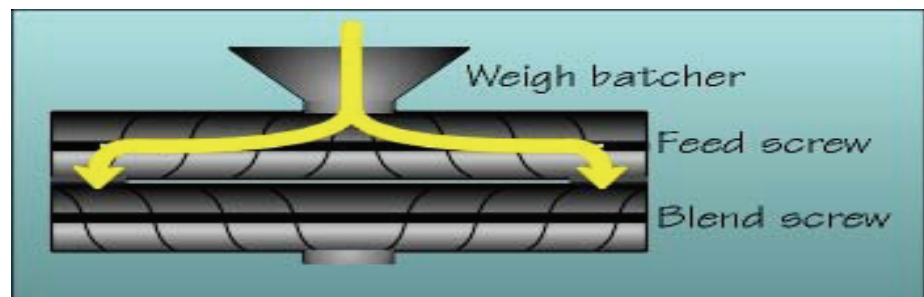
## Improving PCC Mix Consistency and Production by Mixing Improvements

**Objective:** To find optimal mixing procedures for production of a homogeneous and workable mixture and quality concrete using a two-stage mixing operation, including:

- Achieving optimal mixing energy and time for a homogeneous cementitious material
- Characterizing the homogeneity and flow property of the pastes
- Investigating effective methods for coating aggregate particles with cement slurry
- Studying the effect of the two-stage mixing procedure on concrete properties
- Improving production rates

**Reports:** Final Report, February 2008

**Implementation:** The Iowa DOT will use this two-stage mixing operation in demonstration projects. This is intended to lead to development of a new specification for the process.



Batching process for the Hydromix two-stage mixing operation - *Photo: Hydromix Inc., 2007*

## TR-507

**Agency:**  
Iowa State University

**Principal Investigator:**  
Charles Jahren

**Research Period:**  
November 1, 2003 to  
April 30, 2007

**Research Board Funding:**  
\$86,373

**Funding Source:**  
100% State -  
20% Primary funds,  
20% Secondary funds  
and 60% Street funds

## Thin Maintenance Surfaces: Phase III - Municipal Streets and Low Volume Rural Roads

**Objective:** To fully develop a thin maintenance surface technology transfer program specifically for municipal and secondary road personnel.

The program will be developed to fit the specific needs of the following groups:

- Municipal and county engineers
- Consulting engineers and contractors involved in secondary road and street maintenance
- Secondary road and street superintendents
- Officials involved in street maintenance for small municipalities

**Reports:** Final Report, August 2007

**Implementation:** The technology transfer program will be based on the findings from Phases I and II of this research program. Researchers will work with a focus group of the target audience to develop effective material including report(s) and a manual of practice.



Application of the night test section in West Des Moines, Iowa

## TR-516

**Agency:**  
Iowa State University

**Principal Investigator:**  
David J. White

**Research Period:**  
May 1, 2004 to  
April 30, 2008

**Research Board Funding:**  
\$40,000

**Funding Source:**  
100% State -  
75% Primary funds,  
15% Secondary funds  
and 10% Street funds

## Measurement of Seasonal Changes and Spatial Variation in Pavement Subgrade Support Properties - A Link to Pavement Performance

**Objective:** Objectives are to:

- Conduct field tests on newly compacted subgrade (after construction and prior to paving) to document spatial variation in stiffness parameters.
- Monitor changes in subgrade stiffness due to seasonal variation in moisture and temperature.
- Measure the influence of matric suction (difference of pore air pressure and pore water pressure) and the water content of the soil in the laboratory to establish a database for Iowa soil types.

**Reports:** Final Report, July 2008

**Implementation:** The resulting technology transfer will be incorporated into the final report of the Embankment Quality Phase IV TR-492 project. It is envisioned that the conclusions will be used as a basis for developing proposed statewide specification changes.

The research findings and conclusions will be disseminated through electronic distribution of the final report, the Iowa DOT and CTRE Web sites, and through local and regional presentation. It is also expected that the final recommendations will be implemented at the national level through publication of technical papers and presentation at TRB in Washington, D.C.



Existing non-uniform subgrade after pavement removal



Re-compacted uniform subgrade prior to placement of new pavement



## TR-517

**Agency:**

University of  
Nebraska - Lincoln

**Principal  
Investigator:**

Dean L. Sicking and  
Ronald K. Faller

**Research Period:**

April 1, 2004 to  
December 31, 2005

**Research Board  
Funding:**

\$24,995

**Funding Source:**

100% State -  
45% Primary funds,  
45% Secondary funds  
and 10% Street funds

## Guidelines for Safety Treatment of Roadside Culverts

**Objective:** To develop general guidelines for safety treatment alternatives for cross-drainage culverts. Cost-effective analysis procedures will be utilized to determine traffic characteristics and roadside geometries for which each of the above safety treatments are most cost-beneficial.

**Progress:** A draft final report is currently being reviewed and the final report is expected to be delivered by the end of 2008.

**Reports:** None

**Implementation:** Generalized guidelines for safety treatment of cross-drainage culverts will greatly simplify development of plans for reconstruction, rehabilitation & resurfacing (3R) projects. These guidelines will provide reasonably accurate and consistent safety treatment designs for roadside cross-drainage culverts. Further, the simplified design guidelines will significantly reduce the effort required to develop safety treatment plans for roadside cross-drainage culverts.

It is anticipated that the Iowa DOT will be able to immediately implement the simplified design guidelines developed under the study proposed herein. A short seminar will be presented at the end of this study in order to train Iowa highway designers in the application of the guidelines.



Crew excavating Mahaska County site for placement of culvert

## TR-518

**Agency:**

Iowa State University  
and Robert J. Dexter

**Principal Investigator:**

Terry J. Wipf and  
Robert J. Dexter

**Research Period:**

July 1, 2004 to  
September 30, 2008

**Research Board Funding:**

\$80,819 (Iowa State  
University - \$59,519;  
Robert J. Dexter -  
\$21,300)

**Funding Source:**

100% State -  
100% Primary funds

## Monitoring Wind-Induced Vibrations/Stresses in a High-Mast Lighting Tower

**Objective:** To instrument and monitor a high-mast tower in the I-35/US 18 interchange near Clear Lake for at least one year to determine vibration types and stress ranges induced at various wind velocities. The natural frequencies and damping characteristics of a number of towers will be evaluated and are very important in the investigation/evaluation of towers.

The objective is to collect long-term behavior information on the performance of one of the eight high-mast lighting towers for the purpose of validating assumptions made previously in an analytical investigation of these and similar towers.

**Progress:** This project has been completed. A **Phase II** study (TR-562) began in mid 2006. The draft final report is currently under review.

**Reports:** Draft Final Report, December 2006

**Implementation:** The research should provide information to revise/improve the AASHTO Standard Specifications for structural supports for highway signs, luminaries, and traffic signals. This, in turn will improve the design of future towers and the retrofit of existing towers in Iowa and nationwide.

The research has the potential to result in considerable savings for the Iowa DOT in inspection manpower and tower retrofit and/or replacement costs.



Replacement tower base

## TR-519 Phase II

**Agency:**

United States  
Geological Survey  
(USGS)

**Principal  
Investigator:**

David Eash

**Research Period:**

June 1, 2004 to  
September 30, 2009

**Research Board  
Funding:**

\$243,622

**Funding Source:**

44.3% Federal funds  
and 55.7% State -  
45% Primary funds,  
45% Secondary funds  
and 10% Street funds

## Implementing a StreamStats Web Site for Iowa and Developing Flood-Estimation Equations for Small and Large Drainage Basins

**Objective:** To develop a comprehensive flood-estimation method for unregulated, rural streams in Iowa. Specifically, to:

- Implement an interactive StreamStats Web site for all of Iowa that allows users to easily select stream sites and estimate flood-frequency discharges by automating the measurement of basin characteristics and calculation of regression estimates
- Develop two sets of regional regression equations to estimate 2-, 5-, 10-, 25-, 50-, 100-, 200-, and 500-year flood-frequency discharges
- Develop the smallest drainage-area range for a transition zone as possible for Iowa to prevent the possibility of small-basin regression estimates exceeding large-basin regression estimates

**Progress:** The objectives for Phase I have been accomplished. Additional Phase II funding for the implementation of StreamStats was approved and work has begun.

**Reports:** None

**Implementation:** This study will provide a flood-estimation method that will enable engineers, managers, and planners to estimate flood-frequency discharges for small drainage basins with great predictive accuracy.

Regional regression equations developed will only include basin characteristics that are considered easy for users to apply. The probabilistic rational method of flood estimation developed in this study will present runoff coefficient and rainfall frequency maps of the state from which users will determine runoff and rainfall values for small drainage basins.

The study will produce a standard USGS Scientific Investigation Report that will describe the study and present example applications of flood-estimation methods.

## TR-520

**Agency:**  
Iowa State University

**Principal Investigator:**  
James K. Cable

**Research Period:**  
August 1, 2004 to  
July 31, 2008

**Research Board Funding:**  
\$146,708

**Funding Source:**  
100% State -  
95% Secondary funds  
and 5% Street funds

## Evaluation of Dowel Bar Retrofits for Local Road Pavements

**Objective:** This research will:

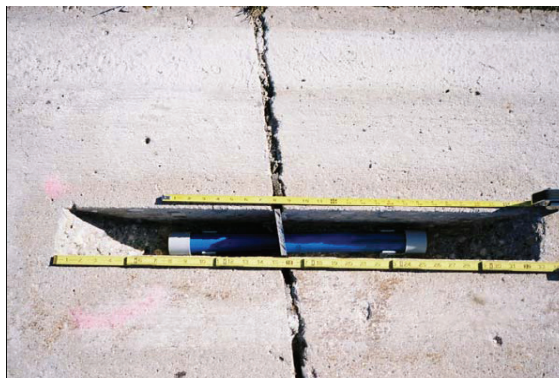
- Evaluate the feasibility of using elliptical or round dowels to retrofit an 8" depth local road pavement as part of a retrofit/grind rehabilitation project.
- Evaluate the impact of applying two, three or four dowels in the outer wheel path only on pavement performance.
- Evaluate the impact of utilizing FRP or steel dowels in the retrofit of the test pavement, on long-term performance.
- Determinate the relative cost of elliptical shaped dowels (FRP and steel) for the retrofit project.

**Reports:** Final Report, February 2008

**Implementation:** The report provides guidance on the:

- Relative number of dowels per joint required to achieve a given level of performance
- Relative costs vs. performance of the various dowel material types
- Potential benefits of dowel bar retrofits versus overlay alternatives for this type of pavement rehabilitation

The results of this research are expected to provide guidance to local government officials in the use of dowel bar retrofits as a method of rehabilitation. This will provide local governments with an alternative to extensive overlays or reconstruction of such pavements.



Proper Slot  
Length



## TR-522

**Agency:**  
Iowa State University

**Principal Investigator:**  
F. Wayne Klaiber

**Research Period:**  
November 1, 2004 to  
August 31, 2007

**Research Board Funding:**  
\$274,780

**Funding Source:**  
100 % State -  
95 % Secondary  
funds and 5 % Street  
funds

## Investigation of Steel Stringer Bridges: Substructures and Superstructures

**Objective:** To develop procedures for assessing, rehabilitating, strengthening and replacing inadequate substructure components or entire substructures and to develop methods to more accurately evaluate and rate non-composite, steel stringer concrete deck bridges.

**Reports:** Final Report, October 2007

**Implementation:** By employing the substructure evaluation procedure, bridge owners will be able to evaluate the strength of the elements in various types of substructure. Procedures for replacing deficient substructure elements or the entire substructure will be developed.

By using the rating factor developed in this part of the investigation, it will be possible to more accurately evaluate existing non-composite steel stringer concrete deck bridges. In some cases it should be possible to remove posting and obtain several more years of service from a particular bridge.



During removal of a bridge in Humboldt County, testing of the super- and sub-structure is made - instrumentation on the piling is visible

## TR-523

**Agency:**

Iowa State University

**Principal Investigator:**

Shauna Hallmark  
Neal Hawkins  
David Plazak

**Research Period:**

December 1, 2004 to  
October 31, 2007

**Research Board Funding:**

\$94,782

**Funding Source:**

100 % State -  
25 % Primary funds,  
70 % Secondary  
funds and 5 % Street  
funds

## Appropriate Traffic Calming Techniques for Small Iowa Communities

**Objective:** The purpose of this research is to evaluate and provide guidance on the use of different traffic calming techniques that can be used by both engineers and communities to select economically feasible alternatives for conditions typical of Iowa's county roads and other major roads within small rural communities.

**Reports:** Final Report, December 2007

**Implementation:** The information from this research will be combined with other traffic studies literature into a practical workshop which could be administered by the Local Technical Assistance Program (LTAP).



View of Drakesville, Iowa, center island as drivers enter the main area of town from the east

## TR-525

**Agency:**  
Iowa State University

**Principal Investigator:**  
Vernon R. Schaefer

**Research Period:**  
November 1, 2004 to  
August 31, 2007

**Research Board Funding:**  
\$153,212

**Funding Source:**  
100 % State -  
40 % Primary funds,  
50 % Secondary  
funds and 10 % Street  
funds

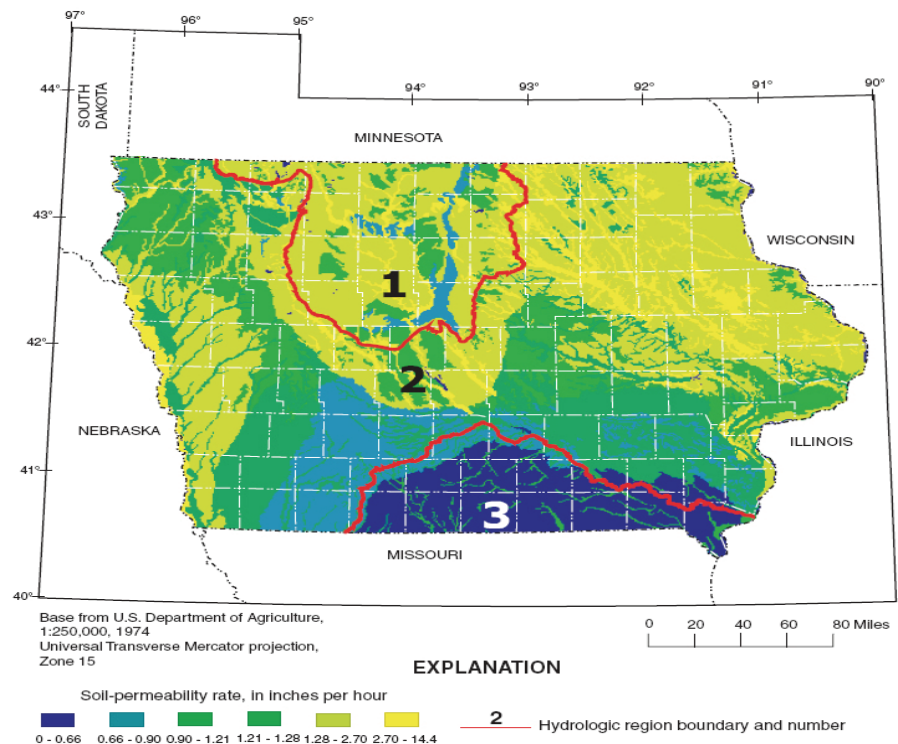
## Design Guide for Improved Quality of Roadway Subgrades and Subbases

**Objective:** To analyze, synthesize, and present in a practical design guide, the findings of recent research relating to subbase and subgrade from Iowa and other states. The design guide will be incorporated into the Iowa DOT and SUDAS manuals.

Construction practices for subgrades and subbases will be reviewed and analyzed so as to identify typical problems that can occur due to poor construction practices. An assessment of stabilization and treatment techniques in relation to construction of subgrades and subbases will be conducted with the goal of selecting reliable geotechnical and foundation treatments. The purpose and expected outcome of best practices for different subgrade and subbase types and treatments will be outlined.

**Reports:** Final report, September 2008

**Implementation:** The conclusions and design guide from this study will provide recommendations on roadway subgrade and subbase design. The design guide and integrated best practices will be incorporated as a chapter in the Statewide Urban Design Manual and the specification recommendations will be included in the Statewide Urban Specifications Manual.



Shaded soil-permeability rates and hydrologic regions in Iowa

## TR-528

**Agency:**  
Iowa State University

**Principal Investigator:**  
Neal Hawkins  
Reg Souleyrette

**Research Period:**  
December 31, 2004 to  
May 31, 2007

**Research Board Funding:**  
\$125,000

**Funding Source:**  
100 % State -  
33 % Primary funds,  
34 % Secondary  
funds and 33 % Street  
funds

## Development of a New Process for Determining Design Year Traffic

**Objective:** To improve civil engineering design in terms of more consistent roadway performance over the life of the project and develop an alternative and more detailed method for developing traffic projections, creating tools which allow for scenario planning, embracing the traditional planning process and evaluating alternative methods for using existing long range models. In addition, the research seeks to improve the overall relationship between planning and civil transportation design.

**Reports:** Final Report, April 2007

**Implementation:** The research will result in an example methodology along with the actual tools needed to conduct scenario planning and development of traffic forecasts. The results have the potential to change the way traffic impact studies are conducted in allowing for the review of impacts much farther away from a new site than the adjacent intersections.



Peak-hour afternoon congestion on University Avenue, West Des Moines, IA



## TR-529

**Agency:**  
Iowa State University

**Principal Investigator:**  
Brent Phares

**Research Period:**  
February 1, 2005 to  
October 31, 2008

**Research Board Funding:**  
\$154,310

**Funding Source:**  
45 % FHWA,  
31 % Wapello  
County,  
24 % State (IHRB) -  
49 % Primary funds,  
49 % Secondary  
funds and 2 % Street  
funds

## Construction and Evaluation of a Prestressed Concrete Bridge Using Ultra-High Performance Concrete

**Objective:** The overall objectives of the work are to:

- Advance the state-of-the-art in concrete bridge construction technology by constructing the first bridge in the United States to use a novel concrete mix.
- Develop experience in the State of Iowa in the design and construction of bridges using advanced materials.
- Develop recommended design procedures for the shear design of ultra-high performance concrete beams.

**Reports:** Final report, October 2008

**Implementation:** These advances will be useful to all jurisdictions within Iowa by ultimately reducing costs, utilizing a higher strength material with almost zero permeability. This could essentially eliminate deterioration of bridge decks.

The results of this research will be compiled in design recommendations and specifications that potentially may be adopted by the American Association of State Highway and Transportation Officials (AASHTO).



A UHPC prestressed Bridge constructed on Little Soap Road in Wapello County, Iowa

## TR-530

**Agency:**

Iowa State University

**Principal Investigator:**

Brent Phares

**Research Period:**

March 1, 2005 to  
April 30, 2008

**Research Board Funding:**

\$169,433

**Funding Source:**

100 % State -  
48 % Primary funds,  
48 % Secondary  
funds and 4 % Street  
funds

## Development of an Improved Integral Bridge Abutment-to-Approach Slab Connection

**Objective:** The objectives of this project are to:

- Develop an effective approach slab-to-integral abutment connection detail for use on Iowa bridges
- Install a structural monitoring system to document and assess the performance of the connection detail and its effects on overall bridge performance

**Reports:** Final Report (combined with TR-539), June 2008

**Implementation:** The successful development of an integral abutment-to-approach slab connection will be useful to all jurisdictions within Iowa. This improved connection detail will be incorporated into the Iowa DOT standard bridge plans and utilized for state, city and county bridge projects statewide.



Installation of an improved bridge-to-pavement connection detail

## TR-531

**Agency:**  
Iowa State University

**Principal Investigator:**  
David J. White

**Research Period:**  
March 1, 2005 to  
May 31, 2007

**Research Board Funding:**  
\$103,323

**Funding Source:**  
100 % State -  
45 % Primary funds,  
55 % Secondary  
funds

## Effective Shoulder Design and Maintenance

### Objectives:

- Identify practices for design, construction and maintenance of granular shoulders that result in reduced rutting and drop-off, improved safety, reduced maintenance costs and extended performance life with recommendations specific to Iowa materials and conditions.
- Document several granular shoulder sites where poor and good performance has been observed in order to better understand the factors contributing to shoulder problems.
- On a pilot basis, evaluate and compare the performance of several test sections using chemical stabilization and mechanical reinforcement techniques including application of waste and recycled materials in construction.
- Perform a cost/benefit analysis to investigate owner costs of alternative systems.

**Reports:** Final Report, June 2007

**Implementation:** The observations and conclusions from this study will provide recommendations on best practices and maintenance procedures used on granular shoulders. State, county and city transportation agencies/jurisdictions can implement these recommendations. The results of this project will be implemented when specifications and Materials Instructional Memoranda are updated to reflect the findings, and transportation officials make improved project selection decisions by selection of more effective construction materials.



S.S. polymer topically applied to the granular shoulder



## TR-533

**Agency:**

The University of Iowa

**Principal Investigator:**

Allen Bradley

**Research Period:**

March 1, 2005 to  
May 31, 2008

**Research Board Funding:**

\$99,544

**Funding Source:**

100 % State -  
51 % Primary funds,  
45 % Secondary  
funds and 4 % Street  
funds

## Evaluation of Design Flood Frequency Methods for Iowa Streams

**Objective:** The objective of this project is to assess the predictive accuracy of two standard design flood methods, the Rational Method and the National Resource Conservation Service/NRCS (or SCS) method, for flood frequency estimation on Iowa streams. The evaluation will be based on comparisons of flood frequency estimates at sites with sufficiently long stream gage records.

**Progress:** A set of 46 streamgages were chosen from the Midwest region, each with a drainage area of 200 acres or less and 20 or more years of record. A flood frequency was estimated for each site using standard statistical methods. Watershed characteristics were collected and stored for each of the 46 basins; the flood frequency was estimated using the Rational Method and the NRCS curve number approach. Comparisons of the design methods were made to address the differences and an alternative flood frequency estimation technique was developed in order to mitigate the differences between the two design methods.

**Reports:** None

**Implementation:** The results of this project will be most relevant to city and county engineers, who are frequently engaged in design and planning of stormwater management facilities for changing land use conditions. Research findings will be presented to the Iowa Stormwater Comprehensive Workgroup, which plays an advisory role in SUDAS. The evaluation may result in specific recommendations for changes in the current SUDAS procedures.



A stream in southern Iowa overflows its banks in August 2007, closing a rural county road.



## TR-534

**Agency:**

The University of Iowa

**Principal Investigator:**

Thanos Papanicolaou

**Research Period:**

May 1, 2005 to  
October 31, 2007

**Research Board Funding:**

\$140,000

**Funding Source:**

100 % State -  
48 % Primary funds,  
48 % Secondary  
funds and 4 % Street  
funds

## Design Procedures and Field Monitoring of Submerged Barbs for Streambank Protection

**Objectives:** To model hydraulically the performance of a proposed submerged barb design for the US-169 bridge site and perform a comprehensive field study involving the design, installation and monitoring of submerged barbs at the same site.

**Reports:** Final Report, September 2007

**Implementation:** The results of this research provide:

- Specifications on the range of flow conditions that are detrimental for bank erosion and scour around barb structures.
- A classification of barbs based on their hydraulic performance under various flow conditions.
- Criteria regarding the stability of the structures for future design recommendations.
- A detailed technical report describing the performance of the recommended structures, as well as summarizing the performances of alternative structures.



Students use an Eagle Fish Elite 480 fish-finding sonar/GPS mounted to a tow fish for depth measurements on the Raccoon River near Adel, Iowa.

## TR-536

**Agency:**

The University of Iowa

**Principal Investigator:**

Marian Muste

**Research Period:**

April 1, 2005 to  
December 31, 2008

**Research Board Funding:**

\$44,048

**Funding Source:**

100 % State -  
55 % Primary funds,  
40 % Secondary  
funds and 5 % Street  
funds

## Implementation of the Water Quality Control BMPs and Design and Specifications Manuals

**Objective:** To incorporate the content of the new best management practices and design and specification manuals for erosion and sediment control measures (currently under development through project TR-508, “Design Guide and Construction Specifications for NPDES Site Runoff Control”) in the existing Web-based erosion control expert system.

**Progress:** Manuals to be incorporated into the interactive Web site are:

- Iowa Construction Site Erosion Control Manual
- Statewide Urban Standard Design and Specification Manuals for Erosion and Sedimentation Control
- Design of Guidelines and Specifications for Improving Stormwater Water Quality

*The Best Management Practices and Design and Specification Guidelines for Erosion and Sedimentation Control* have been incorporated into the interactive manual. The Water Quality section is still under development.

The software is operationally robust and works well.

**Reports:** None

**Implementation:** Once finalized, the Iowa Stormwater Runoff Control Interactive Manual (ISRCIM) will be transferred onto one of the Iowa DOT existing Web servers. Strong outreach, testing and upgrading activities are envisioned during the dissemination of the ISRCIM to a wide category of users; the training programs incorporated in Part 3 of research project TR-508, “Design Guide and Construction Specifications for NPDES Site Runoff Control” presents a major portion of this implementation.

Additionally, training sessions on ISRCIM use will be organized according to requests formulated by IHRB, Iowa cities and counties, and other specialized state offices with responsibilities in the area of sediment, sedimentation and water quality control.

## TR-539

**Agency:**  
Iowa State University

**Principal Investigator:**  
Brent Phares

**Research Period:**  
July 1, 2005 to  
April 30, 2008

**Research Board Funding:**  
\$149,126

**Funding Source:**  
100 % State -  
49 % Primary funds,  
49 % Secondary  
funds and 2 % Street  
funds

## Instrumentation and Monitoring of Precast, Post-tensioned Bridge Approach Pavement

**Objective:** A structural health monitoring system was installed to document and evaluate the performance of a precast, post-tensioned approach pavement and its effects on overall bridge performance. The research team installed a monitoring system to collect overall bridge movement and bridge component strain.

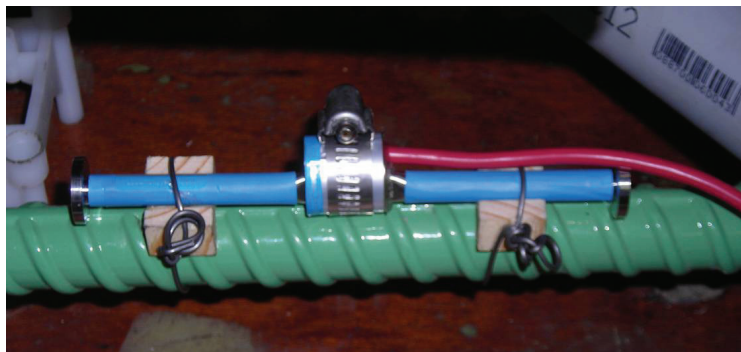
Performance evaluation was formulated through comparisons with recognized codes and standards including the AASHTO specifications.

Demonstrating the benefits of a precast, post-tensioned approach pavement through this pilot project may provide an opportunity for the Iowa DOT to successfully pursue CPTP funding for accelerated construction of other precast concrete pavement projects under the FHWA Highways for Life program.

**Reports:** Final Report, June 2008

**Implementation:** The successful development of a precast, post-tensioned bridge approach pavement system will be a useful extension to the proposed integral abutment-approach slab connection that is currently being studied by the research team under IHRB project TR-530. An improved approach pavement system may be incorporated into the Iowa DOT standard bridge plans and utilized for bridge projects throughout the state.

These results will be distributed to the engineering community through the publication of technical papers in the engineering press and presentations at bridge and transportation conferences, and through posting of pertinent information on the Web site of Iowa DOT's Office of Bridges and Structures and Iowa State University's Bridge Engineering Center Web site.



Photograph of an installed embedded strain gauge

## TR-540

**Agency:**

Iowa State University

**Principal Investigator:**

Shauna Hallmark,  
Neil Hawkins

**Research Period:**

June 1, 2005 to  
March 31, 2008

**Research Board Funding:**

\$124,842

**Funding Source:**

53.6 % State -  
40 % Primary funds,  
58 % Secondary  
funds and 2 % Street  
funds

## Developing Guidance for Use of Lighting on Rural and Urban Roadways in Iowa

**Objective:** To provide agencies in Iowa with information and guidance on the use of lighting so cost-effective decisions can be made. Research will also: Summarize existing lighting guide-lines; Document good lighting practice; Quantify the effectiveness of roadway lighting in reducing the number and severity of night-time crashes; Compare roadway lighting to other safety measures; and Provide information for selection of strategies to reduce night-time crashes from among a range of alternatives and develop recommendations for the use of roadway lighting.

**Reports:** Final Report, February 2008

**Implementation:** The project will result in a lighting guidance document that will be incorporated into SUDAS. The guidance document will provide a rural and urban application matrix which recommends where roadway lighting should be prioritized based upon roadway, land use, safety, and traffic conditions.



Nighttime lighting at N.W. 142<sup>nd</sup> at R38 (Polk County) at dawn – *Photo: Neal Hawkins, Iowa State University/CTRE*



## TR-541

**Agency:**

The University of  
Iowa

**Principal  
Investigator:**

Thanos Papanicolaou

**Research Period:**

Sept 1, 2005 to  
September 30, 2008

**Research Board  
Funding:**

\$63,749

**Funding Source:**

80 % State (IHRB) -  
40 % Primary funds,  
50 % Secondary  
funds and 10 % Street  
funds

## The Effects of Headcut and Knickpoint Propagation on Bridges in Iowa

**Objective:** Research suggests that where headcuts and knickpoints form and migrate, more than 60% of bed erosion occurs in susceptible streams. The objectives of this research are:

- Understand the processes causing formation and migration of headcuts and knickpoints in the field
- Develop a sound but practical model that predicts the formation and migration of headcuts and knickpoints, and associated scour.

**Progress:** Data collection and analysis is ongoing.

**Reports:** None

**Implementation:** Knowledge of the initiation of knickpoint formation will allow the design and construction of grade-stabilization structures at an early stage before sizeable knickpoints have developed.

The specific products of the project will be 1) A practical manual what will aid engineers in monitoring knickpoints, and 2) The development of a model that will predict migration rate and scour depth of knickpoints.



Students conduct bi-annual surveys of the channel morphology at the knickpoint study site along Mug Creek - Photo provided by Dr. Thanos Papanicolaou

## TR-543

**Agency:**  
WHKS & Company

**Principal Investigator:**  
WHKS & Company

**Research Period:**  
July 18, 2005 to  
March 31, 2007

**Research Board Funding:**  
\$673,690

**Funding Source:**

## Development of Three Span Prestressed Concrete Beam Bridge Standards

**Objective:** This project involved bringing the superstructure portion of the current three-span prestressed concrete beam bridge secondary road standards (H24-87 and H30-94 Standards) into conformance with the LRFD specifications, updating the current secondary standards (H24-87 and H30-94) to comply with the Office of Bridges & Structures design manual and policies, and creating new H-Standard for additional roadway widths (40'-0" and 44'-0").

**Reports:** Completed Bridge Standards, March 2007

**Implementation:** The detail sheets are available to all local jurisdictions in Iowa, as well as the Iowa DOT, in Microstation and PDF format on the Iowa DOT Web page at [www.dot.state.ia.us/bridge/index.htm](http://www.dot.state.ia.us/bridge/index.htm).

Cost savings from using these standards rather than using individual consultant designs for each bridge would then be available for use in other parts of the roadway network.



A three-span prestressed concrete bridge constructed in Jones County



## TR-545

**Agency:**

The University of  
Iowa

**Principal  
Investigator:**

Marian Muste  
Peter Haug

**Research Period:**

March 15, 2005 to  
December 31, 2008

**Research Board  
Funding:**

\$144,785

**Funding Source:**

80 % State -  
40 % Primary funds,  
50 % Secondary  
funds and 10 % Street  
funds

## Development of Self-Cleaning Box Culvert Designs

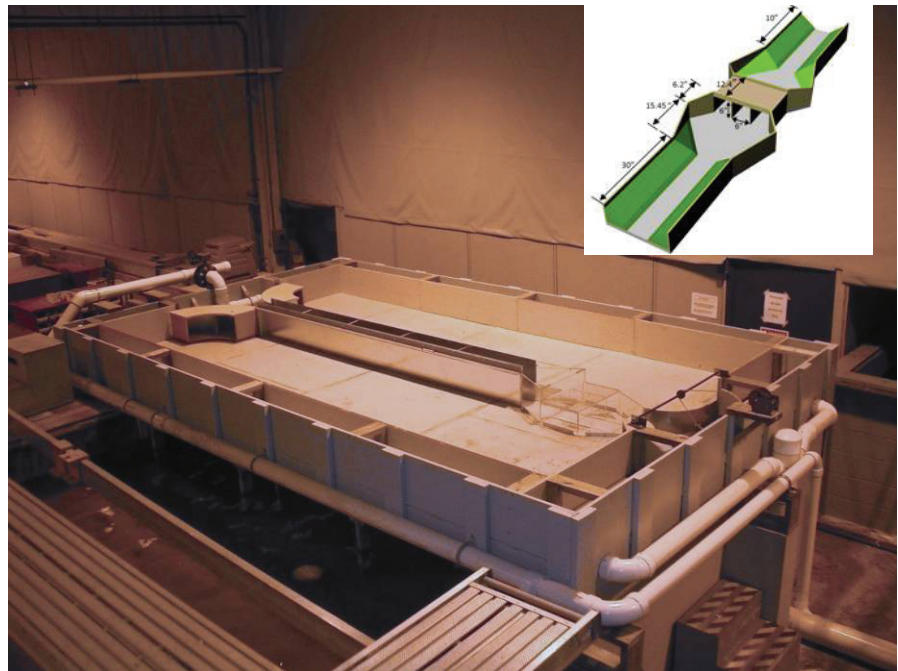
**Objective:** To identify and/or develop methods for constructing or retrofitting box culverts so that the typical flow through a culvert will clean the culvert's barrels and keep the structure performing well with little or no maintenance.

**Progress:** The site visits illustrated that the range of hydraulic conditions that are prone to trigger sedimentation is very diverse, hence a series of experiments were designed to identify these regimes. A new experimental facility was built for this purpose. Tests were initiated in 2007 and are currently in progress.

Three self-cleaning designs have been screened: fillets, vanes, and invert repositioning. Only one is feasible from the constructibility point of view.

**Reports:** None

**Implementation:** The methods identified will be limited to those that can be contained within the right-of-way of the roadway under which the culvert passes. It is anticipated that the results of the project will be applicable to culverts in general.



The laboratory hydraulic model and (insert) schematic of the channel with the 3-barrel culvert geometry – Photo: Dr. Marian Muste, The University of Iowa/IIHR

## TR-546

**Agency:**  
Iowa State University

**Principal Investigator:**  
Neal Hawkins

**Research Period:**  
December 1, 2005 to  
December 31, 2008

**Research Board Funding:**  
\$80,000

**Funding Source:**  
100 % State -  
40 % Primary funds,  
50 % Secondary  
funds and 10 % Street  
funds

## Revision to the SUDAS Traffic Signal Design Guide

**Objective:** To update and publish new Chapter 13 (Traffic Signal Design) and Division 8 (Traffic Signal Specification) documents for the SUDAS manual. This effort will require a significant amount of collaboration with numerous groups including a project advisory group, the SUDAS Traffic Signal Sub-Committee, consultants, contractors, Iowa DOT and municipal agency staff, the signal industry as well as professionals from fields such as electrical, geotechnical and soils engineering.

**Progress:** The design guide is approximately 60% complete. Staff changes have necessitated moving the completion date back.

**Reports:** None

**Implementation:** The findings of this research will be shared through incorporation into the SUDAS manual as well as through presentations at the county engineer conference, MOVITE traffic engineering conference, ASCE transportation conference, APWA conference, and through a variety of other professional, municipal, and national group presentations.



SUDAS specifications are being updated to stay current with new traffic signal technologies and methods used today – Photo: Neal Hawkins, Iowa State University/CTRE

## TR-548

**Agency:**

Iowa State University

**Principal Investigator:**

David Plazak

**Research Period:**

December 1, 2005 to  
April 30, 2007

**Research Board Funding:**

\$80,000

**Funding Source:**

100 % State -  
40 % Primary funds,  
50 % Secondary  
funds and 10 % Street  
funds

## Investigation of the Impact of Rural Development on Secondary Road Systems

**Objective:** To quantify the traffic and fiscal impacts of two common types of rural development on the secondary road system in Iowa; rural residential subdivisions which are commonly found 30 minutes or less from centers of employment, and livestock production facilities which are typically located in remote areas.

**Progress:** This project is nearing completion and key reporting and outreach tasks are being addressed. The analytical portion of this project was completed during the previous year. The draft final report is being prepared at this time. The draft will be reviewed by the TAC and then a presentation scheduled with the Iowa Highway Research Board. Presentations about this project were given in 2006 at the MINK Multistate county engineers conference and to the Iowa County Engineer's Conference. A follow-up presentation was given at the MINK conference in October 2007 and at this time the final impact calculators were shown to counties.

**Reports:** None

**Implementation:** The research team will work with the Iowa Association of Counties and its affiliated groups, LTAP, Iowa State Extension (ISE), Iowa Chapter of the American Planning Association and other associations and agencies who serve to disseminate the research and knowledge of how to use the impact tool. The research team will work with ISE and LTAP to develop a series of informational workshops on the topic of rural development impacts on transportation networks.



A rural residential subdivision located in the middle of prime farmland - *Photo: Susan Deblieck, student, Iowa State University*

## TR-549

**Agency:**  
Iowa State University

**Principal Investigator:**  
Paul Wiegand

**Research Period:**  
December 1, 2005 to  
July 31, 2007

**Research Board Funding:**  
\$112,500

**Funding Source:**  
100 % State -  
40 % Primary funds,  
50 % Secondary  
funds and 10 % Street  
funds

## Roadway Design Standards for Rural and Suburban Subdivisions

**Objective:** A preliminary search of county Web sites indicates that only 28% of Iowa counties have specific subdivision public improvement requirements. The Statewide Urban Design and Specification (SUDAS) and Iowa DOT manuals do not have geometric standards for rural cross-sections on low-volume, low-speed facilities.

This project will determine what standards are currently in place in Iowa and surrounding states for street geometrics, pavement cross-section, width and thickness, as well as the type of facility needed to handle drainage.

**Reports:** Final Report, August 2007

### Implementation:

Once the recommended standards are determined they will be reviewed by the SUDAS program's District SUDAS Committees and Board of Directors to ultimately be incorporated into the SUDAS Design Manual, Chapter 5 (Roadway Design), providing additional geometric design guides and design criteria associated with rural and suburban developments.



An example of a well designed drainage system



## TR-550 Phase II

**Agency:**  
Iowa State University

**Principal Investigator:**  
Halil Ceylan

**Research Period:**  
December 1, 2005 to  
August 31, 2007

**Research Board Funding:**  
\$46,212

**Funding Source:**  
100 % State -  
40 % Primary funds,  
50 % Secondary  
funds and 10 % Street  
funds

## Performance Evaluation of Rubblized Pavements in Iowa

**Objective:** Based on IHRB project TR-473, the primary objective of this study is to evaluate the structural condition of existing rubblized concrete pavements across Iowa through Falling Weight Deflectometer (FWD) tests, Dynamic Cone Penetrometer (DCP) tests, visual pavement distress surveys, etc. Through back-calculation of FWD deflection data, the rubblized layer modulus values will be determined for various projects and compared with each other for correlating with long term pavement performance.

The results will be useful in establishing design modulus and for providing AASHTO layer coefficient recommendations for rubblized PCC layers.

**Reports:** Final Report, April 2008

**Implementation:** The results of this study may result in better estimates of the minimum HMA overlay thickness required for rubblized concrete pavements. If successful, the Iowa DOT and the counties may implement the validated procedure for design of HMA overlay thickness for rubblized concrete pavements.



Layer condition underneath HMA after coring - (Right) PCC layer without rubblization on IA-139 in Winneshiek County, Iowa and (Left) Rubblized PCC layer on IA-3 in Delaware County, Iowa

## TR-551

**Agency:**  
Iowa State University

**Principal Investigator:**  
Neal Hawkins

**Research Period:**  
January 1, 2006 to  
December 31, 2008

**Research Board Funding:**  
\$157,081

**Funding Source:**  
100 % State -  
40 % Primary funds,  
50 % Secondary  
funds and 10 % Street  
funds

## Local Agency Pavement Marking Plan

**Objective:** The study assists local agencies which rely heavily on contractors for application of pavement markings by producing a Reflectivity Guideline to assist in identifying needs due to wear or marking damage over the winter and in developing marking needs and priorities each spring, in addition to:

- Developing a County and City pavement marking application matrix which will provide guidance on the selection of marking materials based on roadway type, pavement service life, user needs, and other factors specific to local agency conditions.
- Addressing quality control issues for cities and counties to improve the efficiency and effectiveness of pavement markings on all marked public roadways.

**Progress:** Continuing to work on case study data collection for Counties and Cities. Continuing to monitor test decks in West Des Moines and Dallas County.

**Reports:** None

**Implementation:** The findings of this research will be shared through presentations at the County Engineer conference, the ASCE Transportation Conference, the APWA conference, and through a variety of other professional, municipal, and national group presentations. The guidelines developed could eventually be incorporated into a pavement marking design section within the SUDAS manual.



One goal of this project is to find new products and methods for improving both durability and retroreflectivity of centerline markings.



## TR-552

**Agency:**

Iowa State University/  
USDA

**Principal Investigator:**

F.W. Klaiber/M.  
LaViolette

**Research Period:**

April 1, 2006 to  
September 30, 2007

**Research Board Funding:**

\$99,960

**Funding Source:**

100 % State -  
40 % Primary funds,  
50 % Secondary  
funds and 10 % Street  
funds

## Field Evaluation of Timber Preservation Treatments in Iowa Highway Applications

**Objective:** To evaluate the performance of various wood preservatives in the field with particular focus on preservative treatments used in Iowa, although additional information at the national level (where pertinent to Iowa), will also be included in the project scope.

Current specifications and testing procedures will be reviewed and correlated with inspection findings in an effort to assess adequacy of initial treatment and the effects of treatment barrier compromise on durability. Recommendations will be made following this assessment.

**Reports:** Final Report, January 2008

**Implementation:** Because this topic has national implications and due to involvement by the Forest Products Laboratory (which provides national support to various governmental agencies related to wood systems), it is anticipated that many other states and counties will be interested in the results of the project.

These results will be distributed to the engineering community through the publication of technical papers in the engineering press and presentations at bridge and transportation conferences and workshops. Information will be distributed to the wood utilization community and preservation industry through publications in the *Forest Products Journal*, as Forest Products Laboratory General Technical Reports, and through presentations at wood preservation conferences. Additionally, posting of pertinent information on Web sites of the ISU Bridge Engineering Center and the Forest Products Laboratory will be made.

If the Iowa DOT Office of Bridges and Structures is interested in modifying existing standards and/or special provisions for the treatment of timber structural systems this research, it could prove valuable for subsequent implementation. The office will be informed of progress during the study and have representation on the PAC.

## TR-553

**Agency:**

The University of  
Iowa

**Principal  
Investigator:**

Hosin “David” Lee

**Research Period:**

April 1, 2006 to  
March 31, 2008

**Research Board  
Funding:**

\$100,000

**Funding Source:**

100 % State -  
40 % Primary funds,  
50 % Secondary  
funds and 10 % Street  
funds

## Examination for Curing Criteria for Cold In-Place Recycling

**Objective:** To advance Iowa’s development of asphalt recycling technology using technically sound and more effective ways to identify minimum in-place CIR properties necessary to permit placement of the HMA overlay or chip seal.

**Reports:** Final Report, February 2008

**Implementation:** Research efforts focus on procedures that will minimize the CIR exposure time while retaining the potential for the owner agency’s investment to succeed; this includes minimizing the risk of CIR layer and HMA damages.

One of the procedures to be researched is a maturity curve for CIR layer under various curing conditions. The research will develop a better analysis tool that the industry and owner agencies can apply to monitor the CIR layer in preparation for a timely placement of the wearing surface.



Simple Performance Testing Equipment at The University of Iowa.

## TR-554

**Agency:**  
Iowa State University

**Principal Investigator:**  
David White

**Research Period:**  
May 1, 2006 to  
April 30, 2008

**Research Board Funding:**  
\$149,996

**Funding Source:**  
100 % State -  
40 % Primary funds,  
50 % Secondary  
funds and 10 % Street  
funds

## Performance and Evaluation of Concrete Pavement Granular Subbase

**Objective:** To determine if recycled PCC pavement subbase is performing adequately by evaluating representative pavement sections with comparisons to virgin aggregate subbase sections (in particular with respect to the specification changes since 1992) and to evaluate the variation in subbase stiffness and permeability by performing multiple tests within a given test section using partly non-destructive methods (i.e. permeability measurements through core hole, pavement FWD tests, and down hole LWD and DCP tests).

The research will also determine the gradation of the subbase materials using bag samples and non-destructive X-Ray CT scanning of epoxy filled core samples and characterize the ride quality and geometric characteristics of the pavement layer for correlation to the subbase properties. Evaluation of the pavement drainage system at each test section site by inspecting the subdrain outlets will be made with development of suggested material guidelines and specifications for construction of pavements using recycled PCC aggregate for subbase.

**Reports:** Final Report, July 2008

**Implementation:** The conclusions of this study will provide recommendations on the use of recycled PCC aggregate as subbase. The Iowa DOT, county and city transportation agencies and jurisdictions will be responsible for implementing the findings and recommendations.



Lightweight  
deflectometer (LWD)  
test

## TR-555

**Agency:**  
Iowa State University

**Principal Investigator:**  
Chris Williams

**Research Period:**  
April 1, 2006 to  
July 31, 2008

**Research Board Funding:**  
\$75,000

**Funding Source:**  
100 % State -  
40 % Primary funds,  
50 % Secondary  
funds and 10 % Street  
funds

## Evaluation of Hot-Mix Asphalt Moisture Sensitivity Using the Nottingham Test Equipment

**Objective:** This project evaluates the moisture susceptibility of the individual components of HMA through an experimental plan which will isolate different variables. Dynamic Modulus and Flow Number testing will be used to evaluate the moisture susceptibility of the HMA. Research objectives include:

- Compare the test results for materials tested in a moisture saturated environment and a dry environment. The research plan will integrate a range of Iowa DOT asphalt mixtures.
- Use the results obtained from the Dynamic Modulus and Flow Number Tests to develop a new test protocol for determining moisture susceptibility.

**Progress:** Additional equipment was purchased that was needed for the project (no project expense) in the form of a water bath and freezer for conducting freeze/thaw cycling. This equipment will significantly increase mix testing capacity as up to 50 samples can concurrently undergo freeze/thaw conditioning. Testing is ongoing.

**Reports:** None

**Implementation:** Several products will be developed from this project. The research team will deliver concise recommendations on acceptable test protocol conditions and limitations along with appropriate user variability in the draft final and final reports. The final report will include an executive summary. The research team will also provide quarterly progress reports to the Technical Advisory Committee (TAC). The research team will also evaluate different anti-stripping agents.

The implementation plan will include recommendations for integrating moisture testing. This research will also evaluate different anti-stripping agents and their success in mitigating moisture damage; technology developments will be dispersed through electronic (via compact disc) and paper formats.

## TR-556

**Agency:**

Iowa State University

**Principal Investigator:**

Matt Rouse

**Research Period:**

May 1, 2006 to  
December 31, 2007

**Research Board Funding:**

\$89,623

**Funding Source:**

100 % State -  
40 % Primary funds,  
50 % Secondary  
funds and 10 % Street  
funds

## Feasibility Investigation of Segmentally Precast Bridge Piers for Accelerated Construction

**Objective:** To simulate, evaluate and test several component materials, connection details, and component configurations to identify the most cost-effective and structurally advantageous means of constructing a radically different design approach of segmentally precast bridge piers for accelerated construction. The basic proposed pier assembly features steel belts at the ends of segments, external reinforcement of segment joints which have bolted connections, and bearing pads between segments to avoid labor-intensive grouting procedures. This steel belt assembly serves three purposes:

- Reinforcement of fragile concrete corners
- Confinement of the concrete at the ends of the segments to provide additional concrete strength and ductility
- Convenient and aesthetically pleasing means for the connection of the exterior reinforcement plates

**Progress:** Experiments and simulations are complete and a final report is in preparation.

**Reports:** Final Report, July 2008

**Implementation:** Results of the research will include cost-benefit analyses of varying materials and component configurations, calibrated analytical models for future designs, and recommendations for full-scale field prototype demonstrations.



Segmented column joint and foundation prior to testing



## TR-557

**Agency:**  
Iowa State University

**Principal Investigator:**  
Chris Williams

**Research Period:**  
March 1, 2006 to  
April 30, 2008

**Research Board Funding:**  
\$50,000

**Funding Source:**  
100 % State -  
40 % Primary funds,  
50 % Secondary  
funds and 10 % Street  
funds

## Evaluation of Lignin Derived from Agricultural Co-Products as an Antioxidant in Asphalt

**Objective:** To evaluate the potential anti-oxidant activity of lignin and evaluate the technical viability of the concept. To achieve this, the research addresses specific aspects of the technical evaluation of the concept. Specifically, the research will:

- Determine the antioxidant activity of lignin in asphalt for lignins that are currently available or are anticipated to become available in the future.
- Evaluate the range of applicability of the concept to determine if the activity is beneficial in a number of asphalts.

**Reports:** Final Report, May 2008

**Implementation:** Successful completion of the research will provide the technical validation required to continue with a more rigorous research and development activity, which will include a series of performance-based laboratory tests and a demonstration of the concept in a field trial of new highway construction.



The laboratory area in the bioprocessing building at Iowa State University is designed for small-scale studies and analytical activities.

## TR-558

**Agency:**

Iowa State University

**Principal Investigator:**

Muhannad Suleiman

**Research Period:**

July 1, 2006 to  
November 30, 2007

**Research Board Funding:**

\$80,266

**Funding Source:**

100 % State -  
40 % Primary funds,  
50 % Secondary  
funds and 10 % Street  
funds

## Use of Ultra-High Performance Concrete in Geotechnical and Substructure Applications

**Objective:** One quarter of our nation's 590,000 bridges, including their substructures, are currently classified as structurally deficient or functionally obsolete, primarily due to material deterioration. This is driving the engineering community to design durable bridges and infrastructures that can last for a minimum of 75 years with minimal maintenance.

To achieve longer life of bridges, new and innovative materials must be used. Ultra-High Performance Concrete (UHPC) provides a unique combination of durability, strength, ductility and aesthetic flexibility, which not only improves longevity of bridges but can produce long-term cost-effective solutions. Iowa is one of the pioneering states in the use of UHPC in bridge superstructure applications.

The unique engineering properties of UHPC show great potential for producing durable foundation elements, which in turn lead to longer lasting substructures and soil stabilization remedies in different conditions. This research aims to investigate and evaluate the use of UHPC for geotechnical applications related to transportation structures.

**Reports:** Final report, December 2008

**Implementation:** Conclusions from this study will provide recommendations on the use of UHPC in geotechnical applications related to transportation facilities for Iowa engineers. A potential site was discussed with Iowa DOT personnel.



A view of  
completed Mars  
Hill Bridge –  
*Photo: ISU Bridge  
Engineering  
Center 2007*

## TR-559

**Agency:**

The University of Iowa

**Principal Investigator:**

George Constantinescu

**Research Period:**

August 28, 2006 to September 28, 2007

**Research Board Funding:**

\$45,253

**Funding Source:**

100 % State -  
40 % Primary funds,  
50 % Secondary  
funds and 10 % Street  
funds

## Improved Method for Determining Wind Loads on Highway Sign and Traffic-Signal Structures

**Objective:** To obtain information on the airflow around highway sign and traffic signal structures and then to estimate the unsteady forces and moments acting on them using state-of-the-art Computational Fluid Dynamics (CFD) tools including Large Eddy Simulation (LES), to perform structural analysis of the highway sign and traffic structures subjected to these loads, and to study new design ideas for the panels that will include a certain number of holes to reduce the pressure forces acting on them under strong wind conditions.

Additionally, there is a need to determine how best to minimize wind loads on structure supporting signs and lights. Several options are available for doing this:

- Develop improved shape and dimensions of signs and their support structures
- Develop air-flow panels (panels with holes disposed on a certain pattern) to reduce wind loadings (especially drag form) and addition of flow-modifying fixtures

**Reports:** Final Report, January 2008

**Implementation:** The report will present the methodology (e.g., description of CFD and structural analysis codes, parameters, boundary conditions, assumptions, etc.), definition of test cases and presentation of simulation results, comparison among the numerical methods, design recommendations and relevance to other problems of interest to DOT in a clear manner that is easy to understand for engineers.

The essential benefit resulting from the project would be a better understanding of the effects of wind on highway sign and traffic signal structures including a dynamic analysis of the aeroelastic effects and the degree to which the presence of holes disposed in a certain pattern over the main plate of these structures can reduce the wind loads.

## TR-560

**Agency:**  
Iowa State University

**Principal Investigator:**  
Tom Maze

**Research Period:**  
July 1, 2006 to  
December 31, 2008

**Research Board Funding:**  
\$54,814

**Funding Source:**  
100 % State -  
40 % Primary funds,  
50 % Secondary  
funds and 10 % Street  
funds

## Clear Zone – Synthesis of Practice and Benefits of Meeting the Ten-Foot Clear Zone Goal on Urban Streets

**Objective:** To determine the state of the practice of clear zone design guidance (standards) and the experiences other jurisdictions have had with applied clear zone guidance; to identify experience in other jurisdictions with clear zone guidance with respect to application of traffic calming designs and/or context sensitive solutions, and to observe the benefits or drawbacks in Iowa that have resulted from providing ten feet of clear zone or from providing less than the ten foot goal.

**Reports:** Final Report, December 2008

**Implementation:** The project will produce a final report and technology transfer brief. The investigators anticipate making presentations at the Iowa American Society of Civil Engineers (ASCE) transportation engineering conference, the Iowa American Public Works Association (APWA) Chapter conference, and the Missouri Valley Section of the Institute of Transportation Engineers (MOVITE) chapter of Institute of Transportation Engineers (ITE) biannual conference.

The main benefit of this project will be a better understanding of the benefits of meeting the ten foot clear zone goal and the costs of providing something less than ten feet. The result should also help the Iowa DOT clarify their policy on clear zone width so that there is less uncertainty in the process.



Utility poles along a Des Moines, IA street are within a few feet of the roadway.



## TR-561

**Agency:**  
Iowa State University

**Principal Investigator:**  
Terry Wipf

**Research Period:**  
May 1, 2006 to  
November 30, 2008

**Research Board Funding:**  
\$341,089

**Funding Source:**  
100 % State -  
25 % Primary funds,  
65 % Secondary  
funds and 10 % Street  
funds

## Laboratory and Field Testing and Evaluation of Precast Bridge Elements

**Objective:** To test and evaluate precast components for three separate bridge projects in order to assess overall design, construction, and bridge structural performance, and to design and install monitoring systems and perform laboratory structural tests on bridge specimens that represent structural details for use on the three projects.

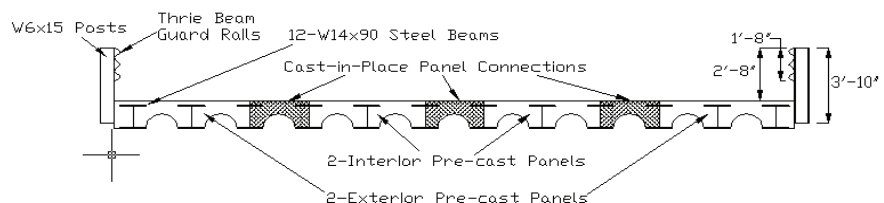
**Progress:** *Boone County:* This portion has been completed.

*Blackhawk County:* Service and ultimate tests were done on the two abutment caps and the third series of pre-cast joints (3 specimens in each series for a total of 9 tests).

*Madison County:* Corrosion instrumentation was installed in the box girders. The placement of the girders at the bridge site was documented. Field testing was done on the bridge and the initial corrosion readings were recorded. A testing plan for the box girders was developed.

**Reports:** None

**Implementation:** Demonstrating the benefits of precast, post-tensioned bridge components through this project may provide an opportunity for the Iowa DOT and Iowa County Engineers to design and construct more cost-effective and durable bridges. The benefits derived from developing accelerated construction concepts may also be significant.



Cross Sections of the Pre-Cast Modified Beam-in-Slab Bridge (PMBISB)

## TR-562

**Agency:**

Robert Connor &  
Assoc

**Principal Investigator:**

Robert Connor &  
Bruce Brakke (Iowa  
DOT)

**Research Period:**

July 14, 2006 to  
September 30, 2008

**Research Board Funding:**

\$36,755

**Funding Source:**

100 % State -  
100 % Primary funds

## Field Instrumentation and Testing of High-Mast Lighting Towers in the State of Iowa

**Objective:** The Iowa DOT owns 233 high-mast lighting towers ranging from 100' to 180' tall. In 2003, a 140' tower collapsed due to a fracture at the welded connection at the base plate. Subsequently, cracks were found in twenty other towers. In addition to cracks at the base plate, a crack was also found at the welded access opening detail on one tower; cracked towers were removed from service.

The goal is to determine how the reinforcing jacket affects the tower's response to wind induced vibrations and to also determine the magnitude of stresses in both the jacket and the original tower, including the anchor rods.

**Progress:** The field work for the research project to Monitoring Wind-Induced Vibrations/Stresses in a High-Mast Lighting Tower was started in the summer of 2006, with the goal of collecting data for a least one year. The instrumentation is providing information as intended from the original tower shell, the bolted reinforcing jacket and the anchor rods. It has been decided to continue to collect additional data in order to better understand the tower's long-term response to wind.

**Reports:** A draft final report is currently being written and a final report is expected in early 2009.

**Implementation:** The research will likely provide a more cost effective repair to cracked high-mast towers and a more efficient retrofit for un-cracked towers with fatigue susceptible details. The Iowa DOT would be able to expeditiously address the problems associated with these towers at a large cost savings.



Bolted Reinforcing Jacket



A bolted reinforcing jacket was placed on a tower in the I-35 & US 18 Interchange near Clear Lake.

## **TR-563** **(TPF-5, 148)**

**Agency:**  
Minnesota  
Department of  
Transportation

**Principal Investigator:**  
Tim Clyne  
(Minnesota  
Department of  
Transportation)

**Research Period:**  
July 2006 to  
July 2009

**Research Board Funding:**  
\$105,000

**Funding Source:**  
100 % State -  
40 % Primary funds,  
50 % Secondary  
funds and 10 % Street  
funds

# **The Effects of Implements of Husbandry "Farm Equipment" on Pavement Performance (MnROAD Study)**

**Objective:** To determine the pavement response under various types of agricultural equipment (including the impacts of different tires and additional axles) and to compare this response to that under a typical 5-axle semi tractor-trailer. This may be accomplished by constructing new instrumented test sections at MnROAD and/or to retrofit instrumentation into the existing test sections. The final scope and work plan for the study will be developed by the participating agencies.

**Progress:** Three iterations of testing have been completed; fall, 2007; and spring and fall, 2008. These tests have included a wide range of vehicles and configurations. Testing will continue through 2009.

**Reports:** None

**Implementation:** This research will allow policy and design decision-making to be driven by direct experimental results rather than by models that may not have been calibrated for the types of loadings and tire configurations of current and evolving agricultural equipment.



Agricultural equipment traveling on a rural roadway

## TR-564

**Agency:**  
Digital Control, Inc.

**Principal Investigator:**  
LaDon Jones

**Research Period:**  
September 1, 2006 to  
June 30, 2009

**Research Board Funding:**  
\$52,000

**Funding Source:**  
100 % State -  
40 % Primary funds,  
50 % Secondary  
funds and 10 % Street  
funds

## Adding Scour Estimation to the Iowa Bridge Backwater Software

**Objective:** To add a new major component to the *Iowa Bridge Backwater* software (published in 2003), *The Estimation of Scour at Bridges*. Adding scour estimation will be the most significant portion of this project and provide a valuable time saving tool for city, county and state engineers.

In addition to scour, the following items will also be completed as part of Version 2 of the software as suggested by users of the current software:

- Improved convergence and iteration on backwater with overtopping
- Improved label scaling on plots and graphs
- Design flowrate copying
- Updated User Manual
- Online Help

**Progress:** Completed tasks include: Improved convergence and iteration on backwater with overtopping; improved label scaling on plots and graphs; and design flowrate copying. Estimation of scour at bridges is approximately 60% complete.

Tasks to be addressed include updating the user manual and on-line help.

**Reports:** None

**Implementation:** The Iowa Bridge Backwater Version 2 software will be utilized by city and county engineers, the Iowa DOT staff and consultants for the design of bridges along the State's primary and secondary road system.

One copy of the program will be provided to each county engineer's office in Iowa.



## TR-565

**Agency:**  
Snyder & Associates

**Principal Investigator:**  
Wade Greiman

**Research Period:**  
August 1, 2006 to  
September 30, 2007

**Research Board Funding:**  
\$188,929

**Funding Source:**  
100 % State -  
40 % Primary funds,  
50 % Secondary  
funds and 10 % Street  
funds

## Review of Inconsistencies Between SUDAS and Iowa DOT Specifications – Phase II: Implementation of Recommendations Into SUDAS Specifications

**Objective:** To improve Iowa DOT Standard Specifications to include items of work typically associated with construction in urban areas; rather than duplicating work already performed in the development of the Statewide Urban Design and Specifications (SUDAS), this project will adopt, by reference, portions that apply uniquely to urban items of work.

**Phase 1** - This first step, Review of Inconsistencies Between DOT and SUDAS Specifications, is completed. Both sets of specifications and standard drawings were reviewed in detail.

**Phase 2** - Recommendations from Phase 1 will be applied for the selected sections, incorporating them into the SUDAS Specifications and standard drawings. **Phase II** will focus on revising those areas the Phase 1 review committee identified as being the highest priority for the Iowa DOT's successful utilization of the SUDAS Specifications. These areas include: trench and backfill, trenchless construction, storm and sanitary sewers, water mains, manholes, intakes, sidewalks, recreational trails, driveways, and utility locations.

**Reports:** Final Report, April 2008

**Implementation:** The Iowa DOT will adopt, by reference, recommendations that apply to urban items of work. The result would be uniform specifications that can be applied to urban work statewide, likely resulting in lowered construction costs and improved quality. Consistency will result in how items are constructed, what materials are used, and how measurement and payment are made will be gained.

## TR-566

**Agency:**

Iowa State University

**Principal Investigator:**

Larry Stevens

**Research Period:**

December 1, 2006 to  
May 31, 2009

**Research Board Funding:**

\$165,316

**Funding Source:**

100 % State -  
40 % Primary funds,  
50 % Secondary  
funds and 10 % Street  
funds

## Utility Cut Repair Techniques – Investigation of Improved Utility Cut Repair Techniques to Reduce Settlement in Repaired Areas: Phase II

**Objective:** Based on the results of Phase I, the research team will monitor the constructed utility cuts for two more years, construct new trenches using the three methods suggested by the research team in Phase I and instrument utility trenches to further understand the mechanisms of trench backfill settlement and load distribution.

The research in **Phase II** examines utility cut construction practices by continued monitoring of restored cuts and improving the understanding of trench settlement and load transfer through the instrumentation of utility trenches. The goal of increasing the pavement patch life and reducing the maintenance of the repaired areas is priority.

**Progress:** Visits were made to multiple sites in Ames, Des Moines, Davenport, and Cedar Rapids to obtain elevations measurements and to continue monitoring settlement. Four sites in Ames, Des Moines and Cedar Rapids have been tested using the FWD.

Three of the recommended trenches to be constructed for monitoring are being monitored using elevation surveys and FWD testing. Instrumented trenches have been installed. A summary of all of the data from the site visits and lab tests has been prepared.

**Reports:** None

**Implementation:** The observations and conclusions from this study will provide recommendations on effective utility cut repairs. State, county and city transportation agencies and jurisdictions can implement the recommendations for utility cut repairs. It is anticipated that the best practices manual will be incorporated as a chapter into the Statewide Urban Design and Specifications (SUDAS) Design Manual, and that the specification recommendations will be included in the SUDAS Specifications Manual.

## TR-567

**Agency:**

The University of Iowa

**Principal Investigator:**

Thanos Papanicolaou

**Research Period:**

August 1, 2006 to September 30, 2009

**Research Board Funding:**

\$112,000

**Funding Source:**

100 % State -  
40 % Primary funds,  
50 % Secondary  
funds and 10 % Street  
funds

## Development of Stage Discharge Relations for Ungaged Bridge Waterways in Western Iowa

**Objective:** To establish stage-discharge relationships for ten ungaged streams in western Iowa through implementation of a semi-automatic sensor network. This project seeks to describe and document knickpoint propagation and identify and prioritize at-risk sites, thereby avoiding potential safety and asset risks due to knickpoint propagation and channel vertical shift.

**Progress:** Water levels and velocity and stream discharge measurements are ongoing.

**Reports:** None

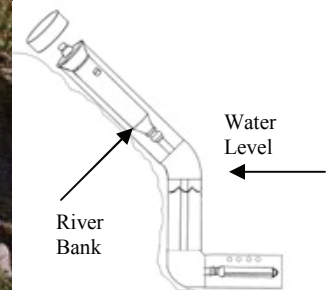
**Implementation:** This research will provide stage-discharge relations for small to medium size ungaged streams in western Iowa and comparisons with other ongoing studies, a tool for predicting river response based on discharge data, explain scour and erosion processes at bridge waterways while indicating how past, present, and possible future changes in river or stream dynamics may affect bridge waterway stability as a function of discharge.

Description and documentation of knickpoint propagation in the HCA region will aid in identifying and prioritizing at-risk sites, thereby avoiding potential safety and asset risks due to knickpoint propagation and channel vertical shift.

Main findings would presented at conferences and information made available to those interested agencies.



Installation of Water Level Loggers(left) and drawing (below) of Logger Placement



## TR-568

**Agency:**

Iowa State University

**Principal Investigator:**

David J. White

**Research Period:**

January 1, 2007 to  
December 31, 2009

**Research Board Funding:**

\$153,912

**Funding Source:**

100 % State -  
40 % Primary funds,  
50 % Secondary  
funds and 10 % Street  
funds

## Modified Sheet Pile Abutments for Low Volume Bridges

**Objective:** To develop a design approach for sheet pile bridge abutments for short span, low-volume bridges including calculation of lateral stresses from retained soil and bearing support for the superstructure; formulate an instrumentation and monitoring plan to evaluate performance of sheet pile abutment systems including evaluation of lateral structural forces and bending stresses in the sheet pile sections.

Also, to evaluate and understand the cost and construction effort associated with building the sheet pile bridge abutment demonstration project and materials that provide recommendations for use and potential limitations of sheet pile bridge abutment systems.

**Progress:** Three sites were selected, one each in Boone, Tama and Blackhawk counties. Construction is expected to begin by the middle of summer, 2008. Soil investigations and characterizations are ongoing at each site.

**Reports:** None

**Implementation:** The final report will provide recommendations for site investigation and design of sheet pile bridge abutments for LVRs. A summary sheet will be made available at appropriate local and regional conferences.

The observations and conclusions from this study will provide recommendations for use of sheet pile abutments in LVRs and in-situ soil testing. County engineers (responsible for 80% of Iowa's LVRs) can implement recommendations for use of an alternative abutment system.



Modified sheet pile abutments



## TR-569

**Agency:**

The University of  
Iowa

**Principal  
Investigator:**  
Marian Muste

**Research Period:**  
January 15, 2007 to  
August 15, 2008

**Research Board  
Funding:**  
\$85,891

**Funding Source:**  
100 % State -  
40 % Primary funds,  
50 % Secondary  
funds and 10 % Street  
funds

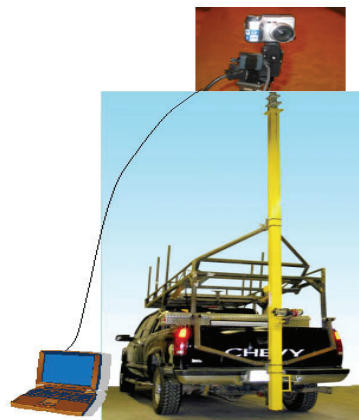
## Quantitative Mapping of Waterways Characteristics at Bridge Sites

**Objective:** The short term and immediate purpose is to dramatically improve current capabilities for quantifying and monitoring bridge scour. Eventually this methodology can be refined to include long term development of bridge monitoring platforms. These platforms would be comprised of multiple non-intrusive instruments (image, acoustic-, and laser-based principles proven through this research), allowing cost effective, informative, comprehensive measurements with improved accuracy and information detail at minimal effort and expense. This methodology is especially well suited for monitoring small bridges typical in Iowa and surrounding states.

**Reports:** Final Report, December 2008

**Implementation:** A software package that calculates quantitative mapping of bridge waterways will be developed and be a modular structure so equipment interchange and addition of hardware can be easily accommodated. The code developed will be an open source to all interested parties. Companion user manuals will be provided instructing users on methodology background and implementation.

The details of the Mobile Large-Scale Particle Image Velocimetry (MLSPIV) truck-based prototype will be available for users willing to construct such observational platforms with demonstrations for various interested user groups to illustrate the prototype's developed capabilities. The final report will be issued and delivered in both electronic and hard copy formats.



MLSPIV unit with mast  
deployed and ancillary  
equipment

## TR-570

**Agency:**  
Iowa State University

**Principal Investigator:**  
Muhannad Suleiman

**Research Period:**  
March 1, 2007 to  
February 28, 2009

**Research Board Funding:**  
\$174,980

**Funding Source:**  
100 % State -  
40 % Primary funds,  
50 % Secondary  
funds and 10 % Street  
funds

## Identification of Practices, Design, Construction, and Repair Using Trenchless Technology

**Objective:** To collect and analyze information recommending practices for design, construction and repair using trenchless technology for use by state and local jurisdictions; these recommendations will be a synthesis of known field practices and/or documented research from studies conducted as part of this research, which can be used by jurisdictions in their utility and restoration permit process.

These recommendations will be proposed for incorporation into the Statewide Urban Design and Specifications (SUDAS) Design Manual Chapter 14.

**Progress:** The research team is about 70% done with the literature review. This will document methods of trenchless technology and their effects on surrounding soil and adjacent structures. The research team has sent the on-line survey to several state and industry engineers across Iowa and surrounding states.

The research team started the field evaluation by visiting seventeen sites. In total, 41 site visits were conducted to observe construction and collect information about the site as well as collect soil samples. Ground heave of about 1' was observed on one of the visited projects. This project is the Iowa State University football practice field.

**Reports:** None

**Implementation:** The observations and conclusions from this study will provide recommendations on effective utility installation and repair. State, county and city transportation agencies/ jurisdictions can implement the recommendations for utility construction or repair.

It is anticipated that the best practices recommendations will be incorporated in the SUDAS Design Manual and the specification recommendations will be included in the SUDAS Specifications Manual.

In addition to the written report, a summary sheet will be created and presentations will be made at appropriate local and regional conferences and the research team will publish the results in refereed journals.

## TR-571

**Agency:**

Iowa Department of  
Natural Resources -  
Geological Survey

**Principal  
Investigator:**

Robert D. Libra

**Research Period:**

May 1, 2007 to  
April 30, 2008

**Research Board  
Funding:**

\$86,357

**Funding Source:**

100 % State -  
40 % Primary funds,  
50 % Secondary  
funds and 10 % Street  
funds

## GIS - Based Decision and Outreach Tools for Aggregate Source Management

**Objective:** To create useful statewide mapping tools for Iowa DOT and local entities with a focus on initial investigations, including locations and descriptions of aggregate resource and factors with implications for extraction; consultation with county planning and zoning officials (Iowa State Association of Counties-County Zoning Affiliate), Iowa DOT Office of Materials and the Iowa Limestone Producers Association (ILPA) will assure development of tools that best address aggregate resources and the barriers to aggregate access.

**Reports:** Final Report, September 2008

**Implementation:** The final product will be delivered in two mediums for two specific audiences: shapefiles created of historical and current quarry operations for the State, with data linked as specified by Iowa DOT for staff use and the Internet Map Service (IMS) created for use by Iowa DOT, planning groups and the public.

This data will be used in planning aggregate source access prior to planning and development of residential/business subdivisions. Internet Map Service with GIS layers relevant to aggregate access planning and education with National standard GIS metadata will accompany all layers/coverages.



Development occurring  
around Crawford and  
Morgan Creek quarries  
in Linn County outside  
of the western city limits  
of Cedar Rapids, IA

## TR-572

**Agency:**

Iowa State University

**Principal Investigator:**

Neal Hawkins

**Research Period:**

June 1, 2007 to  
November 30, 2008

**Research Board Funding:**

\$99,881

**Funding Source:**

100 % State -  
40 % Primary funds,  
60 % Secondary  
funds

## Improving Safety for Slow Moving Vehicles on Iowa's High Speed Rural Roadways

**Objective:** To focus on improving transportation safety for drivers of slow-moving vehicles and other drivers in the proximity of these vehicles on the public roadway system; this work will include the guidance of an advisory panel made up of IHRB members, city and county engineers, City/Iowa DOT planners, industry representatives and other relevant stakeholders.

A matrix of recommended strategies in dealing with agricultural and non-motorized user groups based upon roadway conditions such as speed, shoulder treatment, volume, and frequency of use by these groups and seasonal variations will be made.

**Progress:** A draft final report is currently being written and will be presented for approval in January 2009.

**Reports:** None

**Implementation:** This research seeks to improve safety for both motorists and operators of slow moving vehicles on Iowa's roadways. This work will focus on design and technology improvement strategies which to date have not been addressed in a systematic way based upon crash experience and exposure and will assist technical and nontechnical staff in assessing what can be done to improve safety for slow moving vehicles while providing links to other resources and best practices.



An Amish buggy travels along one of Iowa's high speed rural roads



## TR-573

**Agency:**  
Iowa State University

**Principal Investigator:**  
Sri Sritharan

**Research Period:**  
July 1, 2007 to  
June 30, 2009

**Research Board Funding:**  
\$250,000

**Funding Source:**  
100 % State -  
45 % Primary funds,  
55 % Secondary  
funds

## Development of LRFD Design Procedures for Bridge Piles in Iowa

**Objective:** To examine current pile design and construction procedures used by the Iowa DOT and recommend changes and improvements to those that are consistent with available pile load test data, soils information and bridge design practice recommended by Load and Resistance Factor Design (LRFD). It is a priority to work towards recommended changes that do not significantly increase design and construction costs.

**Progress:** Progress includes:

- Revision and completion of the survey prepared for the Iowa Counties on the LRFD and bridge foundation practice (received responses from about 40% of the Iowa county engineers).
- Continuation of literature review of current LRFD practice, static analysis methods, construction control aspects, and other relevant topics (70% of this subtask has been completed).
- Establishment of a more consistent LRFD resistance factor calibration process for both static and dynamic methods.
- Completion of LRFD resistance factor calculation for all sites with predominantly sand, determining the resistance factor for bridge piles in sand sites in Iowa, and comparing this value with those recommended by AASHTO and other DOTs.

**Reports:** None

**Implementation:** This research will provide direct benefits to bridge infrastructure in Iowa, including the development and implementation of LRFD design procedures for bridge piles in Iowa to ensure the uniform reliability of bridges while providing cost-effective solutions to foundation designs in accordance with the LRFD specifications and local soil conditions.

A training course will be designed for engineers at the Iowa DOT, emphasizing the importance of collaboration between structural, geotechnical and construction engineers. Other participants from transportation agencies will also be attending.

## TR-574

**Agency:**

Iowa State University

**Principal Investigator:**

Terry Wipf

**Research Period:**

April 1, 2007 to  
September 30, 2010

**Research Board Funding:**

\$79,933

**Funding Source:**

100 % State -  
40 % Primary funds,  
50 % Secondary  
funds and 10 % Street  
funds

## Structural Design, Construction and Evaluation of a Prestressed Concrete Bridge Using Ultra High-Performance Concrete Pi Girders

**Objective:** To optimize the design and use of Pi girders while advancing the state-of-the-art in bridge concrete construction technology. In addition, this research will continue to foster an important partnership with FHWA and industry that is contributing to the standardization and use of the next generation of high performance materials.

**Progress:** The bridge was constructed in the fall of 2008 and is currently undergoing load testing and evaluation.

**Reports:** None

**Implementation:** The successful application of ultra high performance concrete (UHPC) will further advance development of cost-effective use for implementation by all jurisdictions within Iowa as ultimately costs are reduced through:

- Taking advantage of a higher strength material.
- Taking advantage of a material with almost zero permeability which could essentially eliminate deterioration of bridge decks.
- The optimization, validation, and acceptance of the proposed girder cross section represent a significant step in more widespread adoption.

The benefits associated with this work will be a reduction in costs associated with bridge construction and, more significantly, reduce costs associated with bridge maintenance.

Further advances with UHPC may yield bridge designs in which the deck and super-structure last for the same duration, thus eliminating the need for intermittent and costly deck replacement. These benefits will be easily quantified at that time by a significant reduction in life-cycle costs associated with bridge ownership.

## TR-576

**Agency:**  
Iowa State University

**Principal Investigator:**  
Chris Williams

**Research Period:**  
August 1, 2007 –  
December 31, 2008

**Research Board Funding:**  
\$39,795

**Funding Source:**  
100 % State -  
40 % Primary funds,  
50 % Secondary  
funds and 10 % Street  
funds

## Investigation of ElectroMagnetic Gauges for Determination of In-Place Density of Hot Mix Asphalt (HMA) Pavements – Phase II

**Objective:** The first phase of this research project found that the electronic gauge technology was promising for use in determining the density of intermediate and surface course mixtures. However, there was indicated a need to understand whether the correction factor obtained in the first day of paving operations for a specific mix and paving conditions is applicable for the ensuing paving days under those same conditions.

The two objectives for this research are to:

- Determine the consistency of gauge correction factors for multiple paving days.
- Determine the number of gauge readings that need to be made for representative quality assurance testing.

**Progress:** Contract Initiated in September, 2007. Delays in the schedule resulted in a no-cost time extension request until December 31, 2008.

**Reports:** None

**Implementation:** The research team will work with the Technical Advisory Committee to develop recommendations for electromagnetic use in quality assurance testing. This will include gauge calibration and/or obtaining gauge correction factors, and determining how they are applied to gauge readings.

## TR-577

**Agency:**

Iowa State University

**Principal Investigator:**

Shauna Hallmark

**Research Period:**

November 1, 2007 –  
December 31, 2010

**Research Board Funding:**

\$53,807

**Funding Source:**

100 % State -  
40 % Primary funds,  
50 % Secondary  
funds and 10 % Street  
funds

## Evaluation of Rumble Stripes on Low-Volume Rural Roads in Iowa

**Objective:** The objectives of this project are to investigate the economic and physical feasibility of installing narrow rumble stripes along the edge of selected paved secondary roads in Iowa. A painted edge line will be placed directly over the rumble strips, thus providing anticipated improved longevity and wet weather visibility of the paint. Evaluation of reduced run-off and drift-off crashes will be undertaken as well as enhanced performance of the painted edge lines.

**Progress:** Seven sites were selected across Iowa for test sections. Grooving and painting were completed (after flood delays) at the end of June, 2008. Data collection and analysis will continue through December, 2010.

**Reports:** None

**Implementation:** Iowa counties, in particular will benefit from this research by obtaining another tool for improving rural roads safety and extending the effective life and wet weather visibility of painted edge lines. With expanded use of this technique, installation costs should be reduced and more common use of rumble stripes may occur. Narrow width installation may also provide more options to the Iowa DOT for future rumble stripe installation on the primary road system.

A test section of rumble stripes and reflective paint completed in June 2008





## TR-578

**Agency:**

The University of Iowa

**Principal Investigator:**

Hosin "David" Lee

**Research Period:**

December 1, 2007 – May 31, 2009

**Research Board Funding:**

\$65,646

**Funding Source:**

100 % State -  
40 % Primary funds,  
50 % Secondary  
funds and 10 % Street  
funds

## Development of Mix Design Process for Cold In-Place Recycling Using Emulsion - Phase III

**Objective:** The first two phases of the research developed and validated the mix design procedure for cold-in-place recycling using foamed asphalt (CIR-foam). They also demonstrated that the field performance of various CIR-foam mixtures could be predicted based on the test results from newly purchased performance testing equipment. The objective of the phase III study is to develop a new mix design process for cold-in-place recycling using an emulsion (CIR-emulsion) by applying the knowledge gained and using the equipment purchased during the previous two phases.

**Progress:** Samples from two county projects in Iowa were obtained and the physical properties of the materials determined. Compaction testing techniques are being developed and evaluated.

**Reports:** None

**Implementation:** Cold-in-place recycling is increasingly being used as the prices of virgin raw materials for paving continue to rise. The results of this Phase III study will provide a mix design process for CIR-emulsion which can be implemented as part of Iowa DOT specifications.



CIR-emulsion mixtures are tested using Interlaken Performance Testing Equipment

## TR-579

**Agency:**  
Iowa State University

**Principal Investigator:**  
Shauna Hallmark

**Research Period:**  
November 1, 2007 –  
October 31, 2011

**Research Board Funding:**  
\$80,000

**Funding Source:**  
100 % State -  
40 % Primary funds,  
50 % Secondary  
funds and 10 % Street  
funds

## Low Cost Strategies to Reduce Speed and Crashes on Curves

**Objective:** The main goal is to evaluate the effectiveness of dynamic speed feedback signs and other low-cost strategies to reduce speeds and crashes on curves. Research results will provide traffic safety and county engineers and other professionals with additional tools to more effectively manage speeds and decrease crashes on horizontal curves on rural roadways.

**Progress:** Contract Initiated in November, 2007.

**Reports:** None

**Implementation:** Iowa counties in particular will benefit from this research by obtaining another tool for improving safety on rural curves. A number of treatments have been used but their effectiveness is not known.

Additionally, use of the project as matching funds to the FHWA project allows us to leverage federal funding to evaluate treatments in Iowa and to be able to compare those results to other sites nationally.



Larger chevrons and curve signs on US 6, Johnson County - Photo: Tom Welch, Iowa DOT Office of Traffic and Safety

## TR-580

**Agency:**

Iowa State University

**Principal Investigator:**

Omar Smadi

**Research Period:**

January 1, 2008 –  
June 30, 2009

**Research Board Funding:**

\$96,113

**Funding Source:**

100 % State -  
40 % Primary funds,  
50 % Secondary  
funds and 10 % Street  
funds

## Pavement Markings and Safety

**Objective:** Using Iowa DOT data under nighttime conditions, this research effort is focused on achieving the following objectives:

- Capitalize on current research efforts and develop a systematic method to compare pavement marking and crash data for a given roadway segment.
- Investigate the impact that varying levels of pavement marking retroreflectivity have on crash performance.
- Use findings to develop strategies for agencies in determining the level of investment needed for pavement markings.

**Progress:** Contract Initiated in January, 2008

**Reports:** None

**Implementation:** This research will assist technical and non-technical staff in assessing pavement marking needs and the impact on safety. These results will be incorporated into the ongoing efforts of the Iowa DOT Pavement Marking Task Force, and will also benefit the Iowa Highway Research Board Local Agency Pavement Marking Plan research efforts and technology outreach.



A pavement marking test deck in Dallas County evaluating experimental centerline markings placed within a groove - Photo: Neal Hawkins, Iowa State University/CTRE



## TR-581

**Agency:**  
Iowa State University

**Principal Investigator:**  
John Verkade &  
Peter Taylor

**Research Period:**  
November 15, 2007 –  
November 14, 2009

**Research Board Funding:**  
\$100,000

**Funding Source:**  
100 % State -  
40 % Primary funds,  
50 % Secondary  
funds and 10 % Street  
funds

## Development of an Improved Agricultural-Based Deicing Product

**Objective:** The objective of this project is to seek agricultural based products that will be suitable for use as deicing materials that are suitably cost effective, environmentally acceptable and technically functional.

**Progress:** Summary of progress to date:

- A literature review has been completed.
- Work has started on evaluating a glycerol based compound
- Commercially available materials are being reviewed for inclusion in the test program
- Names are being selected for the TAC

**Reports:** None

**Implementation:** If a suitable compound can be found, the Iowa DOT will be able to reduce costs associated with deicing and ant-icing, either by the use of a cheaper material, more efficient use of materials, reduced maintenance costs, reduced environmental impact, or some combination of these benefits.



## TR-582

**Agency:**  
Iowa State University

**Principal Investigator:**  
Halil Ceylan

**Research Period:**  
March 1, 2008 –  
February 28, 2010

**Research Board Funding:**  
\$50,000

**Funding Source:**  
100 % State -  
40 % Primary funds,  
50 % Secondary  
funds and 10 % Street  
funds

## Ethanol By-Product Geo-Material Stabilization

**Objective:** The objective of this research is to investigate the utilization of processed corn stover or corn grain fermentation by-product in pavement base/subbase soil stabilization. Specifically, it will:

- Demonstrate the ability of lignin as an effective soil stabilizing agent for lignins that are currently available or are anticipated to become available in the future in abundant supply.
- Evaluate the effect of lignin on the engineering properties of soil-lignin mixtures for Iowa conditions. It is anticipated that the successful completion of the proposed research will lead to extended and rigorous evaluation of this concept both in the lab and in terms of field performance.

**Progress:** Currently, there are no standard methods for evaluating the stability of lignin-soil mixtures in the laboratory. As per the original research plan, the research efforts during this quarter mainly focused on conducting a detailed literature review on soil stabilization techniques and reviewing previous studies related to the use of lignin (derived from paper industry) in pavement geomaterials stabilization. Lignin samples used in this research should be representative of the lignin that is either currently commercially available or may become commercially available in the future as the biorefining industry becomes a reality. Potential lignin samples have been secured by contacting the industry and ISU biofuel research labs. A detailed laboratory test plan has been formulated and this will be finalized in consultation with the Research Advisory Committee.

**Reports:** None

**Implementation:** The usefulness of industrial lignins has been demonstrated by the profitability of the lignin chemicals business operated worldwide. Lignin is also a by-product of ethanol plant production. With the increase in soy/corn based ethanol plant production, new uses of lignin are being developed to provide additional revenue streams to improve the economics of the biorefineries. Modified lignins have already been successfully used as concrete admixtures and as dust suppressants in unpaved roads. Recently they are being evaluated as anti-oxidants in asphalt. Considering the wide range of pavement-related applications in which agricultural derived lignin could be used, the results of this research could result in substantial economic savings for Iowa.

## TR-583

**Agency:**  
Iowa State University

**Principal Investigator:**  
Sri Sritharan

**Research Period:**  
January 1, 2008 –  
December 31, 2009

**Research Board Funding:**  
\$380,000

**Funding Source:**  
100 % State -  
40 % Primary funds,  
50 % Secondary  
funds and 10 % Street  
funds

## Field Testing of Piles and Development of a Wave Equation Method for Pile Design in Iowa

**Objective:** This project has the following objectives: 1) Install and load test piles in the field; 2) Collect complete data including driving data; 3) Improve design of piles in accordance with LRFD specifications; 4) Develop a suitable dynamic analysis method for pile design; and 5) Disseminate research outcomes to bridge designers in Iowa and elsewhere.

**Progress:** Activities in different tasks have been performed which included: 1) performing literature review of dynamic analysis methods; 2) completion of static and dynamic pile tests in Mills and Mahaska counties; 3) conducting in-situ and laboratory soil tests (e.g., CPT, SPT, Borehole Shear Test, sieve analysis, Atterburg Limits, and soil classification) for the test sites in Mills and Mahaska counties; 4) selection of four new test sites in Iowa and prediction of the pile capacity as well as designing of the static load tests and instrumentation plan; 5) conducting CAPWAP analysis for records collected from Mills and Mahaska counties; and 6) conducting GRLWEAP analysis on usable data from the electronic database established in TR-573 and determining resistance factors.

**Reports:** None

**Implementation:** The project team will organize and deliver a training course to supplement the final report and to expedite the implementation of project results into actual design and practice in the field. Designed for engineers in the office of Bridges and Structures, Soils Design Section, and office of Construction at the Iowa DOT, the course will be delivered over a period of one to three days and will clearly emphasize the importance of collaboration between structural, geotechnical, and construction engineers.

Other interested participants from county and city transportation agencies will also be invited. The training course will be largely delivered by the project team members. Depending on need, FHWA experts on LRFD may contribute to the course by providing an overall perspective on the implementation of project outcomes based on their experience with other bridge design agencies.

## TR-584

**Agency:**  
Iowa State University

**Principal Investigator:**  
Sri Sritharan

**Research Period:**  
January 1, 2008 –  
June 30, 2009

**Research Board Funding:**  
\$70,000

**Funding Source:**  
100 % State -  
40 % Primary funds,  
50 % Secondary  
funds and 10 % Street  
funds

## Establishing a Dynamic Formula for Pile Design and Construction Control of Pile Driving

**Objective:** Consistent with LRFD specifications, develop dynamic formulas to design piles and control their installation in the field, focusing on methods suitable for Iowa soil conditions.

**Progress:** Activities performed include:

- Performing literature review of dynamic formula for Pile Design and Construction Control.
- Beginning analysis of usable steel H-pile dataset from the database using six dynamic pile driving formulas (i.e., Gates, FHWA Modified Gates, ENR, Iowa DOT Modified ENR, Janbu and Hiley methods) (25%).
- Participation and contribution to the pile tests in the field for TR-583 and collection the relevant data for this project.
- Updates to the electronic database with information for this project.

**Reports:** None

**Implementation:** The project team will organize and deliver a training course to supplement the final report and to expedite the implementation of project results into actual design and practice in the field. Designed for engineers in the office of Bridges and Structures, Soils Design Section, and office of Construction at the Iowa DOT, the course will be delivered over a period of one to three days and will clearly emphasize the importance of collaboration between structural, geotechnical, and construction engineers.

Other interested participants from county and city transportation agencies will also be invited. The training course will be largely delivered by the project team members. Depending on need, FHWA experts on LRFD may contribute to the course by providing an overall perspective on the implementation of project outcomes based on their experience with other bridge design agencies.

## TR-585

**Agency:**  
United States  
Geological Survey

**Principal Investigator:**  
Jim Giglierano

**Research Period:**  
April 15, 2008–  
September 30, 2009

**Research Board Funding:**  
\$100,000

**Funding Source:**  
100 % State -  
70 % Primary funds,  
30 % Secondary  
funds

## National Agriculture Image Program Participation

**Objective:** The objective of this project is to participate in funding the acquisition of high resolution quality aerial imagery on an annual basis and, in turn, to make it publically available, free of charge. Doing so will reduce duplication of acquisition of aerial imagery by providing a product that will meet the needs of state, county and local officials in a majority of cases. It is imperative that we find ways to combine our limited resources to best meet the needs of those who utilize this imagery on a frequent basis to eliminate the need for costly field inspections to determine existence or changes in features.

**Progress:** Contract Initiated in April, 2008

**Reports:** None

**Implementation:** The USDA Farm Service Agency (FSA) uses this imagery to keep farm records current, verify crop reporting and commodity compliance. Many departments of city, county, and state government use the imagery for a variety of purposes integral to government business such as property appraisal, law enforcement, emergency management, road and bridge maintenance, water resource management, etc. An annual imagery program also allows change detection of photo-identifiable features.

State government in Iowa uses this imagery in multiple ways. In many cases, availability of quality yearly imagery has become a substitute for field visits, saving staff time and mileage. In addition, aerial imagery also enhances the field visits, making staff more efficient by locating features more quickly or identifying potential problems before they become acute.



2008 NAIP imagery of the intersection of US 18 and I-35 in Cerro Gordo County



## TR-586

**Agency:**

The University of  
Iowa

**Principal  
Investigator:**

Hosin “David” Lee

**Research Period:**

April 1, 2008 –  
September 30, 2009

**Research Board  
Funding:**

\$50,000

**Funding Source:**

100 % State -  
40 % Primary funds,  
50 % Secondary  
funds and 10 % Street  
funds

## Pavement Thickness Design for Local Roads in Iowa

**Objective:** The main objectives of this research are to: 1) identify the most critical input parameters by performing a sensitivity analysis, 2) determine the minimum pavement thickness by performing a mechanistic analysis of pavement structure, and 3) develop a new SUDAS pavement design procedure which can provide more appropriate design thicknesses for a broad range of pavement conditions.

**Progress:** Adjoining states have been contacted for surveying their pavement thickness design procedures for low-volume roads in order to identify common factors to be considered for the low-volume pavement design. A survey form has been sent to pavement design engineers in the adjoining states who design pavements on a regular basis. The sensitivity analysis has been performed by varying the design input parameters for StreetPave program by ACPA. The sample computer program was developed to allow pavement design engineers to design both concrete and asphalt pavements and perform a sensitivity analysis. The Technical Advisory Committee (TAC) was formed and the first TAC meeting scheduled to meet in Des Moines in December 2008.

**Reports:** None

**Implementation:** Institutions and individuals who would take leadership in applying the new SUDAS pavement design procedure and software will be identified. Such leaders are likely to come from the engineers from SUDAS board of directors, six SUDAS districts and Iowa DOT, who would use the procedures and they will then publicize the benefits of the new procedure to other cities and counties in Iowa. At the initiation of the project, the research team will recruit such leaders and have them involved in the development process as potential users. They will be invited to serve on the Technical Advisory Committee (TAC), who shall guide the PI and his project team to conduct their research following the established specific objectives. Through a proper guidance by SUDAS board of directors and six districts and measured against specific criteria for judging the progress and specific questions leading to the successful implementation, the research team can periodically adjust the development of new pavement design procedure and software interfaces to meet the demands from the users.

## TR-587

**Agency:**  
Iowa State University

**Principal Investigator:**  
Kejin Wang

**Research Period:**  
March 1, 2008 –  
February 28, 2009

**Research Board Funding:**  
\$40,000

**Funding Source:**  
100 % State -  
40 % Primary funds,  
50 % Secondary  
funds and 10 % Street  
funds

## Impact of Low Shrinkage Mixes on Late-Age Random Cracking in Pavements with Use of Early Entry Sawing

**Objective:** The objective of this project is to investigate whether or not there is an increased risk of delayed random cracking in early-entry-sawed pavements. Since cracking is related to the stress development in concrete, the specific objective of this study is to examine the levels of stresses developed at early entry sawed joints of pavements in comparison to conventional depth joints.

**Progress:** Contract Initiated in March, 2008

**Reports:** None

**Implementation:** The results of the study can be used by the Iowa DOT and the paving industry to identify potential late-age random cracking problems in the pavement constructed with early-entry sawing operations. The results may also provide insights into any modifications of the current early entry operations, such as sawing depth and joint spacing.



Strain gages installed at joints just before paving to monitor the stress resulting from concrete shrinkage (US 34 Fairfield bypass)

## TR-588

**Agency:**  
Stanley Consultants

**Principal Investigator:**  
Larry Badtram

**Research Period:**  
March 1, 2008 –  
June 30, 2008

**Research Board Funding:**  
\$113,239

**Funding Source:**  
100 % State -  
100 % Secondary  
funds

## Update of the Continuous Concrete Bridge Standards (J Standards)

**Objective:** The Iowa Highway Research Board has recently released updated Three Span, Continuous Concrete Slab Bridge Standards (J Standards). The standards were updated to bring the superstructure design up to current LRFD design standards.

At the time of the update, the AASHTO LRFD substructure design standards were not ready for use. Recent changes in Iowa DOT design standards for abutment wings, barrier rail end sections and paving notches have also been completed but were not included in the J standard update.

This project will update the J standards to LRFD substructure design, as well as, to update the barrier rail end section, paving notch, and wing design.

**Reports:** Standards Complete, December 2008

**Implementation:** The detail sheets are available to all local jurisdictions in Iowa, as well as the Iowa DOT, in Microstation and PDF format at: [www.dot.state.ia.us/bridge/index.htm](http://www.dot.state.ia.us/bridge/index.htm).

Cost savings from using these standards rather than using individual consultant designs for each bridge would then be available for use in other parts of the roadway network.



## TR-589

**Agency:**  
National Weather  
Service

**Principal  
Investigator:**  
National Weather  
Service

**Research Period:**  
April 1, 2008 –  
March 31, 2011

**Research Board  
Funding:**  
\$137,937

**Funding Source:**  
100 % State -  
40 % Primary funds,  
50 % Secondary  
funds and 10 % Street  
funds

## Updating U.S. Precipitation Frequency Estimates for the Midwestern Region

**Objective:** The purpose of this study is to determine annual exceedance probabilities and average recurrence intervals for rainfall durations ranging from 5 minutes to 60 days and frequencies from 1-500 years. The study results will be a web based publication.

**Progress:** Contract Initiated in March, 2008

**Reports:** None

**Implementation:** The National Weather Service (NWS) rainfall maps have not been updated for approximately 50 years. This means that the designs of storm sewers, culverts, dams, detention basins, etc. have been performed by the engineering community using outdated data. This project is part of a national effort to update the rainfall/frequency relationships for the entire United States.



This photo was taken in June 2008 at Mile Marker 265 along I-80 looking east. Implementing updated precipitation frequency estimates as a design tool for future projects will help engineers design bridges, culverts, detention basins, storm sewers and other transportation projects more efficiently.



## TR-590

**Agency:**

The University of  
Iowa

**Principal  
Investigator:**

Hosin “David” Lee

**Research Period:**

April 1, 2008 –  
March 31, 2009

**Research Board  
Funding:**

\$57.666

**Funding Source:**

100 % State -  
40 % Primary funds,  
50 % Secondary  
funds and 10 % Street  
funds

## Examination of Curing Criteria for Cold In-Place Recycling (CIR) – Measuring Temperature, Moisture, Deflection and Distress for the Test Section

**Objective:** During the phase I study, research efforts focused on the laboratory experimentation. However, it is suspected that the moisture conditions measured in the laboratory may not be equivalent to the moisture conditions in the field. The main objectives of this phase II study are to:

- Measure the moisture levels throughout a CIR layer
- develop a relationship between field moisture measurements and laboratory moisture measurements
- develop a curing index to determine the optimum curing time for a CIR layer before overlay.

**Progress:** Contract Initiated in May, 2008

**Reports:** None

**Implementation:** The results of the research will be presented as a set of curing indices based on the experimentation to measure moisture and temperature conditions throughout a CIR layer in the field. This curing index will be useful for pavement engineers as it can accurately determine an optimum timing for an overlay to prevent premature failure of the CIR layer and HMA overlay.

## TR-591

**Agency:**  
Iowa State University

**Principal Investigator:**  
Charles Jähren

**Research Period:**  
April 1, 2008 –  
June 30, 2009

**Research Board Funding:**  
\$91,638

**Funding Source:**  
100 % State -  
40 % Primary funds,  
50 % Secondary  
funds and 10 % Street  
funds

## Stabilization Procedures to Mitigate Edge Rutting for Granular Shoulders – Phase II

**Objective:** The objectives of this research are to:

- Determine the relative importance of localized, chronic edge rut issues compared to longer reaches of roadway with more general shoulder edge rut maintenance issues.
- Develop strategies for mitigating edge rut problems using various mixtures and gradations of granular materials and stabilization agents.
- Rate the performance of a subset of the above mentioned strategies.
- Recommend strategies based on the results of test section performance, cost and likely future maintenance procedures.
- Assist the Iowa DOT in implementing use of the recommended strategies.

**Progress:** Contract Initiated in March, 2008

**Reports:** None

**Implementation:** The results of this study are intended to allow maintenance personnel to improve the performance of granular shoulders with regard to edge ruts, with the existing complement of maintenance personnel.

If methods can be devised to lessen the number of times that crews must be redirected in order to address acute edge rut problems in localized chronic areas, greater overall maintenance efficiency will be achieved.

It is anticipated that the results of this project will reduce life cycle costs for granular shoulders, increase safety, and improve the procedures currently in use to maintain granular shoulders in Iowa.

## HR-1027

**Agency:**

Iowa Department of  
Transportation

**Principal****Investigator:**

Edward J. Engle

**Research Period:**

March 1980 –  
on-going

**Research Board****Funding:**

\$85,000/year (covers  
salary and state share  
of costs for FICA,  
IPERS, health  
insurance, vehicle  
costs and expenses)

**Funding Source:**

100% State -  
100% Secondary  
funds

## Secondary Road Research Coordinator

**Objective:** To maintain research liaison with all county engineers and solicit new, innovative and progressive ideas; to actively promote secondary research for solutions to problems and ideas that will improve quality and reduce costs.

**Progress:** Ed Engle continues communications with various county engineers to discuss problems being encountered by the secondary road departments and to discuss present research projects during the year. At present, there are approximately 40 active research projects that involve counties, including secondary projects with consultants.

The coordinator assists these counties with special testing, evaluation and writing of construction and final reports necessary to the research. He has also been keeping county engineers updated on the changes in the IHRB operating procedures.

**Reports:** None

**Implementation:** There are many problems that are unique to the secondary road system in Iowa. These problems are usually common to several counties. Coordination between counties is necessary for understanding the problem and formulating solutions. Proper documentation and dissemination of reports allows for timely technology transfer between the counties.